



## **Atlas of wooden furniture industry in Jepara, Indonesia**

Jean-Marc Roda, Philippe Cadène, Philippe Guizol, Levanía Santoso, Achmad Uzair Fauzan

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# ATLAS OF WOODEN FURNITURE INDUSTRY IN JEPARA, INDONESIA

In this document, we study the industrial district of Jepara, Indonesia. It is specialised in furniture production, for the Indonesian consumption, as well as for worldwide exports. We summarize the main features of the dynamics of the firms involved in the Jepara industrial complex with a quantitative analysis of flows among them, and between them and markets elsewhere. A specific method of spatial analysis has been designed, and merged with other existing methods for the analysis of forest production networks and social networks. This method allows to take in account and to accurately assess the number of very small workshops that can not be evaluated by classical methods. We demonstrate that the extent of wood industry and activities is considerably underestimated by both the official statistics and the existing literature about Jepara. We present the results through synthesis maps. A total of 15 271 units of production have been identified, employing approximately 170 000 workers in Jepara. The activity generates creates a considerable revenue: between 11 900 to 12 300 billions Rp/year of added value (about 1 billion Euros/year), that is to say between 70 to 78 million Rp/worker/year. The district of Jepara consumes between 1.5 to 2.2 millions m<sup>3</sup>/year of round wood, and in other words, we found that the use of around 9 m<sup>3</sup> of round wood, sustain 1 fulltime employee per year. The organisation of the production is typical of an industrial district, with a high level of intertwined relationships and sub-contracting between the production units, a high specialisation of them, and a prevalence of the small and very small units in various steps of the production, compared to the bigger integrated units.



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**French Agricultural Research Centre for International Development**

Research Unit Forest Resources and Public Policies &  
Research Unit Production and Processing of Tropical Woods  
TA B-40/16  
73 Rue Jean-François Breton  
34398 Montpellier Cedex 5  
France  
Tel.: +33 (0)4 6761 4498  
Fax: +33 (0)4 6761 5725  
E-mail: [jean-marc.roda@cirad.fr](mailto:jean-marc.roda@cirad.fr); [philippe.guizol@cirad.fr](mailto:philippe.guizol@cirad.fr)  
Web site: <http://www.cirad.fr/en/index.php>

**Center for International Forestry Research**

Jl. CIFOR, Situ Gede, Sindang Barang  
Bogor Barat 16680, Indonesia  
Tel.: +62 (251) 622622; Fax: +62 (251) 622100  
E-mail: [cifor@cgiar.org](mailto:cifor@cgiar.org)  
Web site: <http://www.cifor.cgiar.org>

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# ATLAS OF WOODEN FURNITURE INDUSTRY IN JEPARA, INDONESIA

## ABSTRACT

In this document, we study the industrial district of Jepara, Indonesia. It is specialised in furniture production, for Indonesian consumption as well as for worldwide exports. We summarize the main features of the dynamics of the firms involved in the Jepara industrial complex with a quantitative analysis of flows among them, and between them and markets elsewhere. A specific method of spatial analysis was designed, and merged with existing methods for the analysis of forest production networks and social networks. This method allows to take into account and to accurately assess the number of very small workshops that cannot be evaluated by classical methods. We demonstrate that both the official statistics and the existing literature about Jepara considerably underestimate the extent of the wood industry and its activities. We present the results through synthesis maps. A total of 15 271 units of production have been identified, employing approximately 170 000 workers in Jepara. The activity generates considerable revenue: between 11 900 and 12 300 billion Rp/year of added value (about 1 billion euros/year), that is to say between 70 and 78 million Rp/worker/year. The district of Jepara consumes between 1.5 and 2.2 million m<sup>3</sup>/year of roundwood, and in other words, we found that the use of around 9 m<sup>3</sup> of roundwood sustains one full-time employee for a year. The organisation of the production is typical of an industrial district, featuring a high level of intertwined relationships and subcontracting among highly specialised production units and a prevalence of small and very small units in various steps of the production rather than bigger, integrated units.

Keywords: Indonesia, Java, furniture, timber, industrial district, production network, manufacturing cluster, flexible specialisation, SME, teak, trade.

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# 1 INTRODUCTION

What drives development? How much of the process is determined by people's assets, skills, and opportunities; by the regulatory environment; or by the location, arrangement, and dynamics of interconnected economic activities? Whereas the first two of these criteria have attracted considerable attention, much less research has been directed at the influence of the intensity and degree of concentration of economic activity. A study of how industrial clusters are organised and function should contribute to a better understanding of this issue. Industrial clusters—localised networks of production, processing and distribution enterprises along the manufacturing and marketing chain—occur throughout the world. Firms in such clusters compete fiercely among themselves, and with similar businesses elsewhere, for inputs and markets. With increasing globalisation, competition with distant firms becomes less direct and more complex. The success of a business may depend increasingly on specialisation and collaboration with other firms in the cluster, promoting economic efficiency and greater competitiveness. In this paper, we study the furniture and associated industries in Jepara, Central Java, Indonesia, to understand these issues and the changes occurring as a result of globalisation.

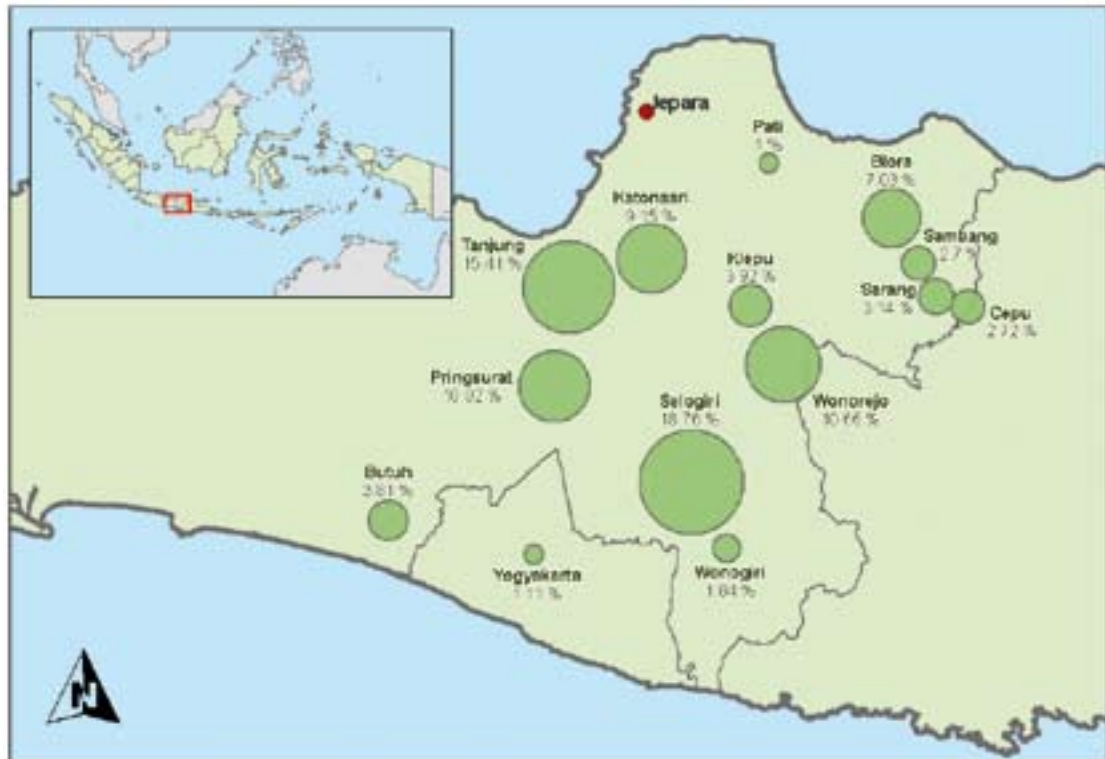
The ancient carving industry in Jepara is famous locally and worldwide. Its reputation has attracted many related economic activities linked to wood production and processing, especially furniture making. Today, Jepara is a typical example of what is called an 'industrial district'<sup>1</sup> in which growth in one sector (furniture manufacturing) has attracted thousands of small to medium-sized industries to the Kabupaten (administrative district)<sup>2</sup>. These in turn have created an opportunity for further subsidiary activities and industries. The many showrooms in Jepara are a microcosm of the range of furniture, designs, know-how, traders, and transport options on offer throughout Java.

## 1 INTRODUCTION

This concentration of industrial activity has stimulated a substantial economic boom in Jepara and surrounding areas and attracted local political support. For example, the need for container trucks to export furniture led the previous Bupati (district administrator) to have some major roads in the district reclassified as 'provincial class' roads. This allowed container trucks to reach most parts of the district, stimulating economic growth by attracting more people and activities, generating new trade and industry, and elevating economic activity around Jepara to a new level. The minimum wage of workers is reputed to be significantly higher in Jepara than in the rest of the province (Schiller 2000).

The dynamic nature of the Jepara industrial complex also affects the Indonesian wood products chain, attracting timber produced from forests located throughout Central Java (Figure 1) and beyond, including the outer islands. Thousands of trucks and pickups bring logs into the district from distant places, including state and community forest plantations. In addition to serving the huge domestic market in Indonesia, Jepara is well connected to foreign markets in the USA, Europe, Japan, Hong Kong, Australia and elsewhere, and thereby acts as a bridge between local people, forests and these global markets.

The broad aim of this research is to strengthen the link between the social and environmental sciences, and to foster a change in observed practices by stimulating a dialogue among those involved in the industry, thereby contributing to sustainable development of the local economy. Our scientific aim is to combine a systematic study of the dynamics of the firms involved in the Jepara industrial complex with a quantitative analysis of flows among them, and between them and markets elsewhere. In this report, we summarise the main features of this complex. The summarised statistics are important because they differ dramatically from those initially assumed by us, and from the figures on the wooden furniture industry in Indonesia given by authorities.



**Figure 1.** Origin of teak wood supplies in Jepara, during June 2004  
(Lazarovici & Schwartzemberg, 2004)





# 2 MATERIAL AND METHODS

## 2.1 Broad approach

The concentration of industries around Jepara and their links to plantations spread across Java produce a number of urban and forestry management problems at a range of scales. This study is therefore organised at several scales using a multidisciplinary approach that combines elements of the natural, social and engineering sciences. A number of specific methods are available to address such multiscaled situations. We use the Forest Products Networks (FPN) method developed by CIRAD for tropical forest product networks (Roda 2004).

Two complementary approaches are used. The first is to understand the furniture production process and the flexibility of different classes of entrepreneur within it. We consider the furniture industry of Jepara both as a specific example of an industrial district and, more generally, as a localised network of enterprises concentrated in a specific area. We analyse the economic and social relationships connecting suppliers, which result in a web of social and economic relations among those involved in production, processing and manufacturing, accompanied by increasing, often hierarchical, differentiation among them. The position of the various participants within this web, and the bonds connecting them to complex and extended family structures, or which they establish with local authorities, are potentially important. We aim to answer the following questions:

- What are the links between the resource production system<sup>3</sup> and the furniture industrial district of Jepara, where hundreds of thousands of jobs are concentrated?
- What have been the recent trends in teak production?

## 2 MATERIAL AND METHODS

The second approach quantifies the goods and the added value involved, as well as the resource and product flows, both to understand the above elements and for its intrinsic scientific interest. To quantify such processes requires development of specific methods to obtain the necessary statistical data.

To understand the global dimensions of the industrial cluster at Jepara, we compare the economic and social processes driving the actions of firms in the industrial district with those located elsewhere in Indonesia and in other countries.

Taking a multiscale approach, as in this study, is in its infancy in the social sciences. Likewise, quantifying the material and information flows among those involved in social and economic networks is a poorly explored field of research. To address these issues required the combination of results from detailed questionnaires with a thorough assessment of the production processes and spatial analysis of sources and sinks, and flows between them. This is then used to differentiate the firms and establish relative weights for the various flows recorded.

## 2.2 Fieldwork method

### 2.2.1 Implementation of the work

The study of the workshops in Jepara involved an initial extensive survey so as to locate all the workshops. Then we designed a spatial grid to prepare the following intensive survey. It consisted of sampling these workshops, creating a detailed database on the structure of the wood industry in Jepara, and subsequently analysing it (Roda and Cadène 2005). The fieldwork was conducted by a team of 12 surveyors<sup>4</sup> and 2 field coordinators<sup>5</sup>. They were equipped with motorbikes, global positioning system (GPS) devices, questionnaires, and computers. The main fieldwork was conducted between June and October 2005. The two steps of the fieldwork were as follows.

#### *Step 1 – extensive survey: simple typology and spatial distribution*

The wood industry in the district of Jepara is not uniformly spatially distributed, but is clustered at different locations and densities, each of which had to be characterised and quantified. At the outset, the position of all industrial or commercial enterprises and workshops that use, process, display, or store wood material, including the smallest family businesses located on even the smallest streets and side roads, was recorded using GPS. Each unit was categorised using a

simple typology based on the main economic activity (workshop, showroom, log park, sawmill, warehouse, and ironmonger), and the size of the unit (small, medium, and large<sup>6</sup>). This produced 18 categories of size-related activity.

#### *Step 2 – intensive survey (qualitative and quantitative survey)*

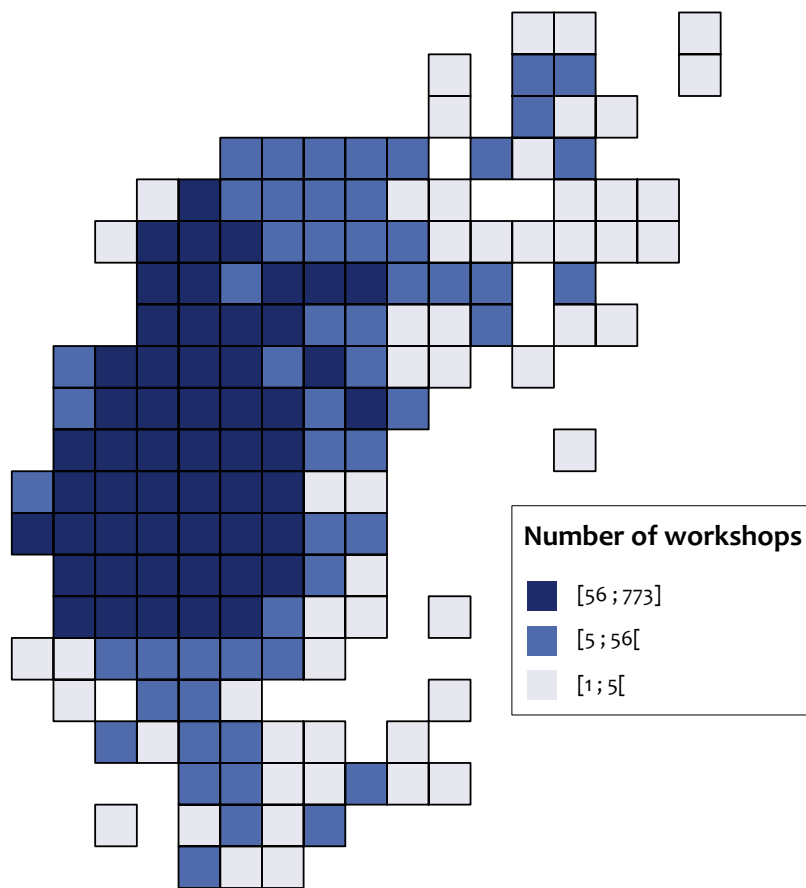
Industry in Jepara comprises a complex network of relationships and flexible subcontracting. The first aim of this survey was therefore to investigate how these relationships are structured, and how production is organised and linked to the different market segments, including the sources of the wood. In addition, we sought to record and quantify these relationships to understand the contribution of a unit of raw material to the employment, education, and social wealth of people in the system<sup>7</sup>.

Given the impossibility of surveying systematically all the small and medium-sized enterprises in Jepara, a statistically representative subsample of enterprises was chosen to reflect all the small and medium enterprises of Jepara (3 500 to 5 000). This second survey documented the enterprises, their products, and their social interactions, relationships, competition, and cooperation. The survey was conducted in one to several iterative steps, depending on the availability of the people being surveyed.

### 2.2.2 Integrating the extensive and intensive surveys

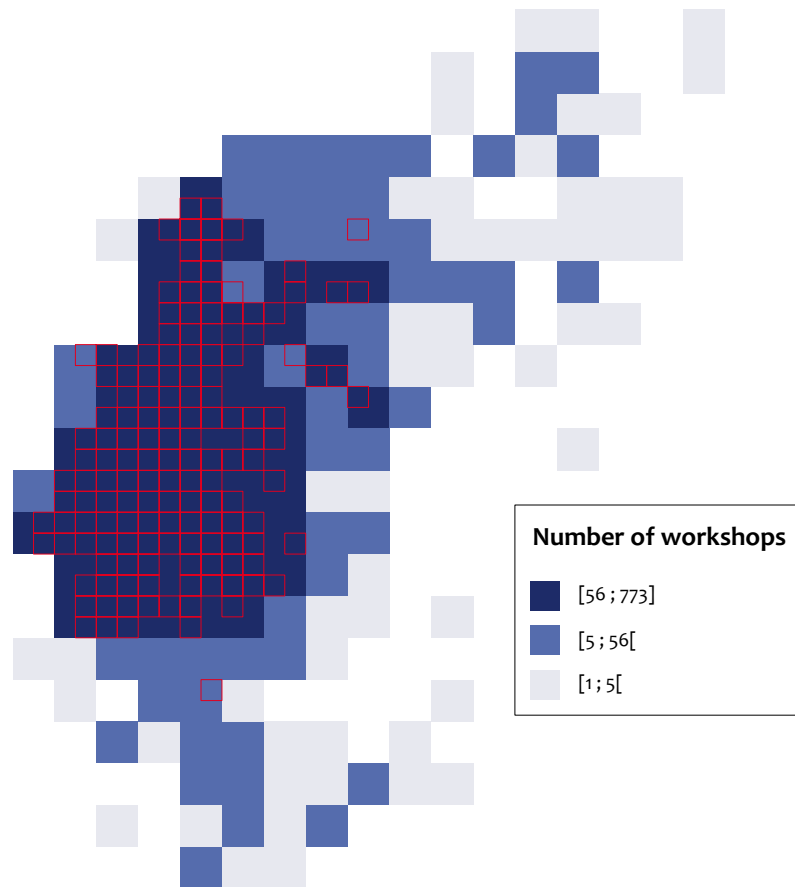
The initial survey showed a high level of spatial heterogeneity in the location of industries in Jepara. For subsequent sampling and more detailed analysis of a subset of these enterprises, the area was divided into squares, each of which would be independently surveyed. The theoretical optimal size of the squares was calculated using the standard interpolation method, with weighted distances. Details are given in Annex 1 and the resulting grid is illustrated in Figure 2.

The spatial heterogeneity is so extreme that 80% of the workshops are located in only 17% of the squares. The remaining squares have a much lower density of workshops and are spread over a wide area. To accommodate this heterogeneity, a smaller grid had to be superimposed on the centre of Jepara, where the concentration of workshops was highest. This was to ensure that adequate information could be obtained from these high density areas. It does not require more work on the field, but provides more spatial information. For one third of the most densely concentrated workshops, one optimized cell was transformed into four finer cells. For example, instead of taking one sample from 744 workshops in one cell, we took four samples from each of four cells containing 186 workshops. Overall, the amount of sampling is the same, as is the number



**Figure 2.** General optimised grid with the number of workshops in each square, according to three quantities of one third of the total number of enterprises each

of workshops visited, but proportionately more workshops are sampled from central Jepara, where the density of businesses is greater. The greatest concentration of workshops (making up one third of all workshops) occurs within the darkest coloured of the three zones in Figure 2. With the finest grid, the square with the highest density of enterprises contains 389 workshops. The finer grid is illustrated in Figure 3.



**Figure 3.** Fine optimised grid

### 2.2.3 Sampling and extrapolation methods

To ensure that this spatial heterogeneity was surveyed in a representative manner, each square was sampled independently in proportion to the number of workshops in each ( $n/N$ , where  $n$  = the number of workshops sampled and  $N$  = the total number of workshops in the square). To choose a value for this sampling proportion, we found a compromise between the need to capture as much

## 2 MATERIAL AND METHODS

of the variation as possible and the constraints of available human and financial resources for the survey. Eventually, the sampling proportion ( $n/N$ ) was fixed at 0.06, or 6% sampling intensity, which is exceptionally high for this kind of socio-economic survey.

The sampling was complicated by the difference in scale between the large and smaller grids. Some of the large squares contain between one and four smaller squares, which necessitated aligning the large and smaller grids, as described in Annex 2.



# 3 RESULTS AND DISCUSSION

## 3.1 The importance of the wood industry in Jepara shown by the extensive survey

A total of 15 271 units (enterprises) were identified, categorised, and their geographic positions established (Table 1). According to the survey, there are at least 14 091 small units (92%), 871 medium units (6%), and 309 large units (2%). These are minimum figures for the size of the industry in Jepara because, although we carried out an almost complete census of existing units, we know that the survey team missed a few workshops and enterprises. Based on our knowledge of the city, we think that the actual number could be 10% higher.

**Table 1.** The number of enterprises in each of the 18 categories of size-related economic activities in Jepara linked to furniture manufacture. Figures showing the spatial distribution of these enterprises are given for each kind of enterprise

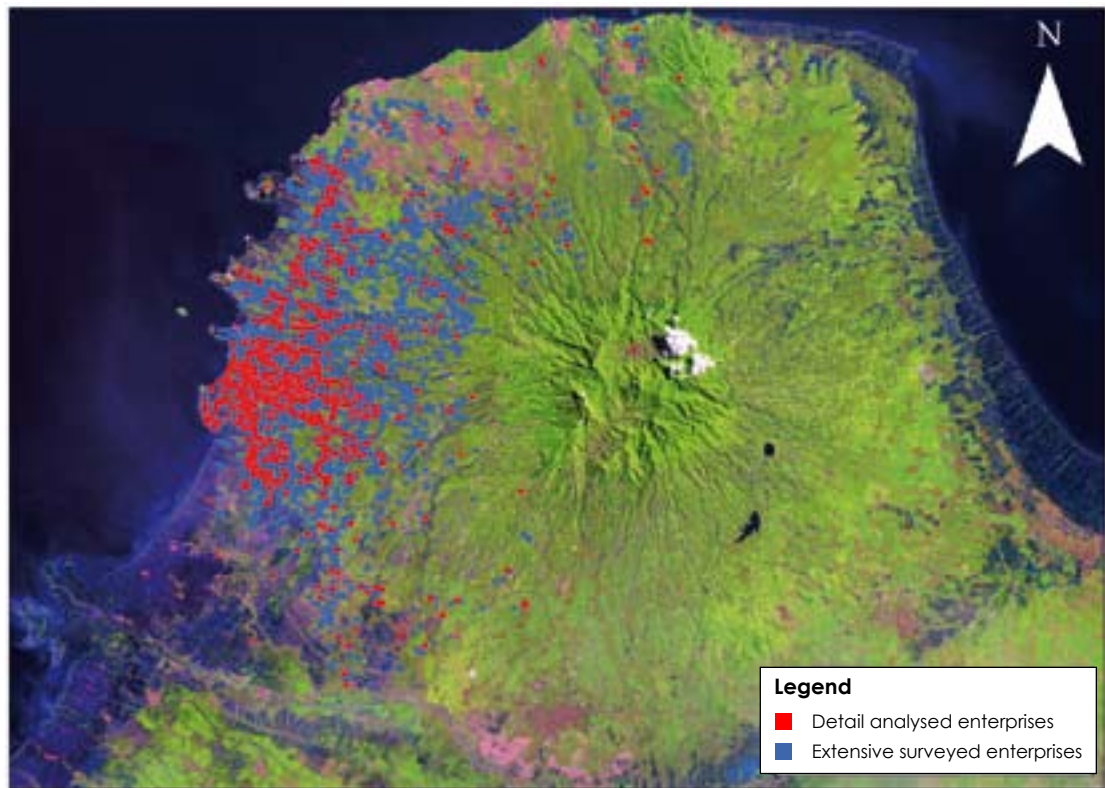
	Workshops (Figure 5)	Showrooms (Figure 6)	Log parks (Figure 7)	Sawmills (Figure 8)	Warehouses (Figure 9)	Ironmongeries (Figure 10)
Small units	12 202	1 250	763	158	210	82
Medium units	435	230	133	74	219	18
Large units	126	68	57	37	146	82
Total	12 763	1 548	953	269	575	109

### 3 RESULTS AND DISCUSSION

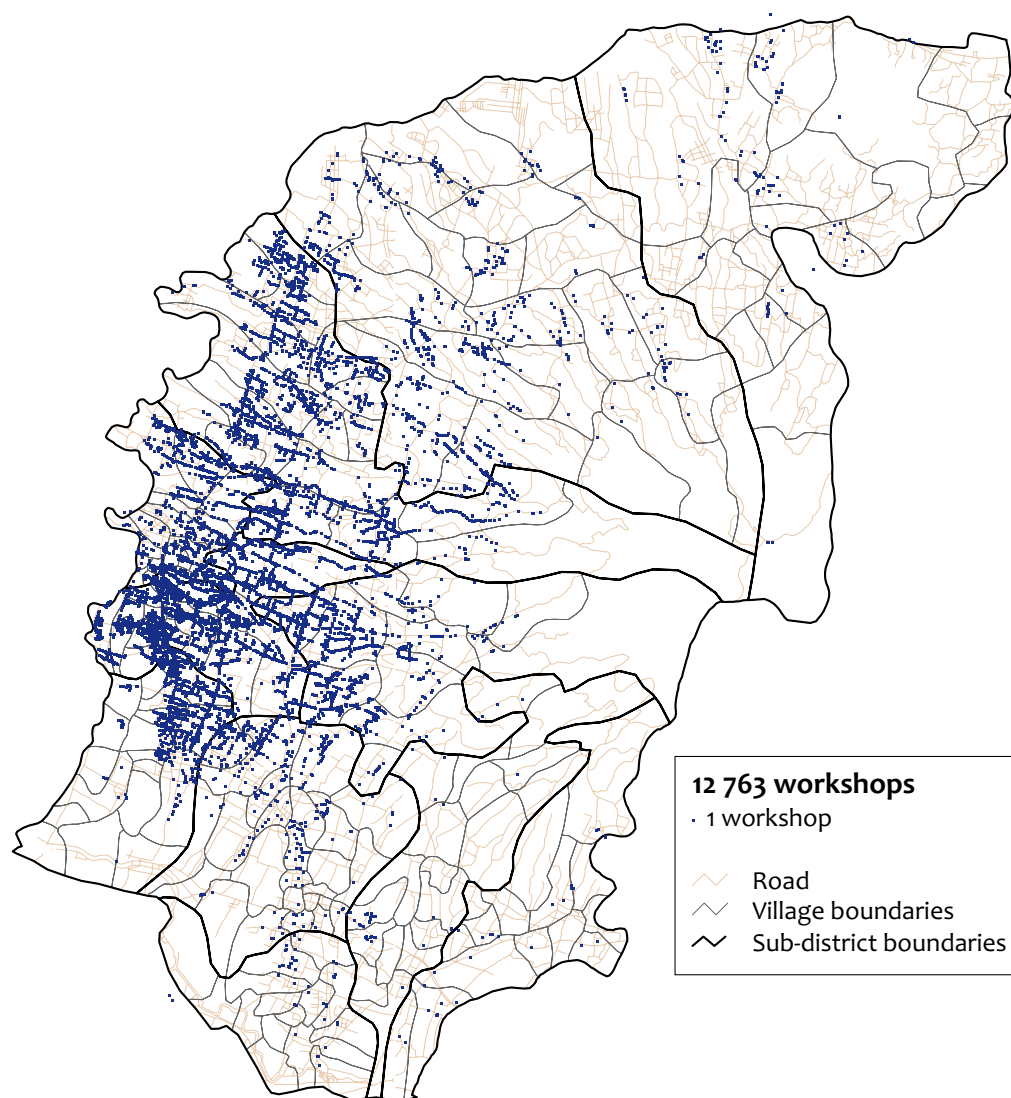
These results show that the existing literature considerably underestimates the reality of the wood industry of Jepara. Using the data on the time of creation of all the enterprises that we surveyed, we were able to deduce the number of enterprises of the furniture cluster back to 1955. Thus, we can assess the magnitude of the error of former studies. This estimated error is a minimum, because the calculation is based on the surviving enterprises, while an unknown number of enterprises have presumably disappeared since these previous studies, implying that the real number of enterprises for each year is equal or greater than the number which we can calculate.

For example, Sulandjari and Rupidara (2003, cited in Posthuma 2003) found 1 026 enterprises in 2000, which is nine times less than what we found (at least 9 000 enterprises in 2000). Similarly, Sandee *et al.* (2002, cited in Posthuma 2003) found 3 000 enterprises in 2002, four times less than what we found (at least 12 000 enterprises in 2002). Finally the Indonesian administration (District Office of Industry 2005, cited in Loebis and Schmitz 2005), found 3 700 enterprises in 2002, that is to say three times less than what we found.

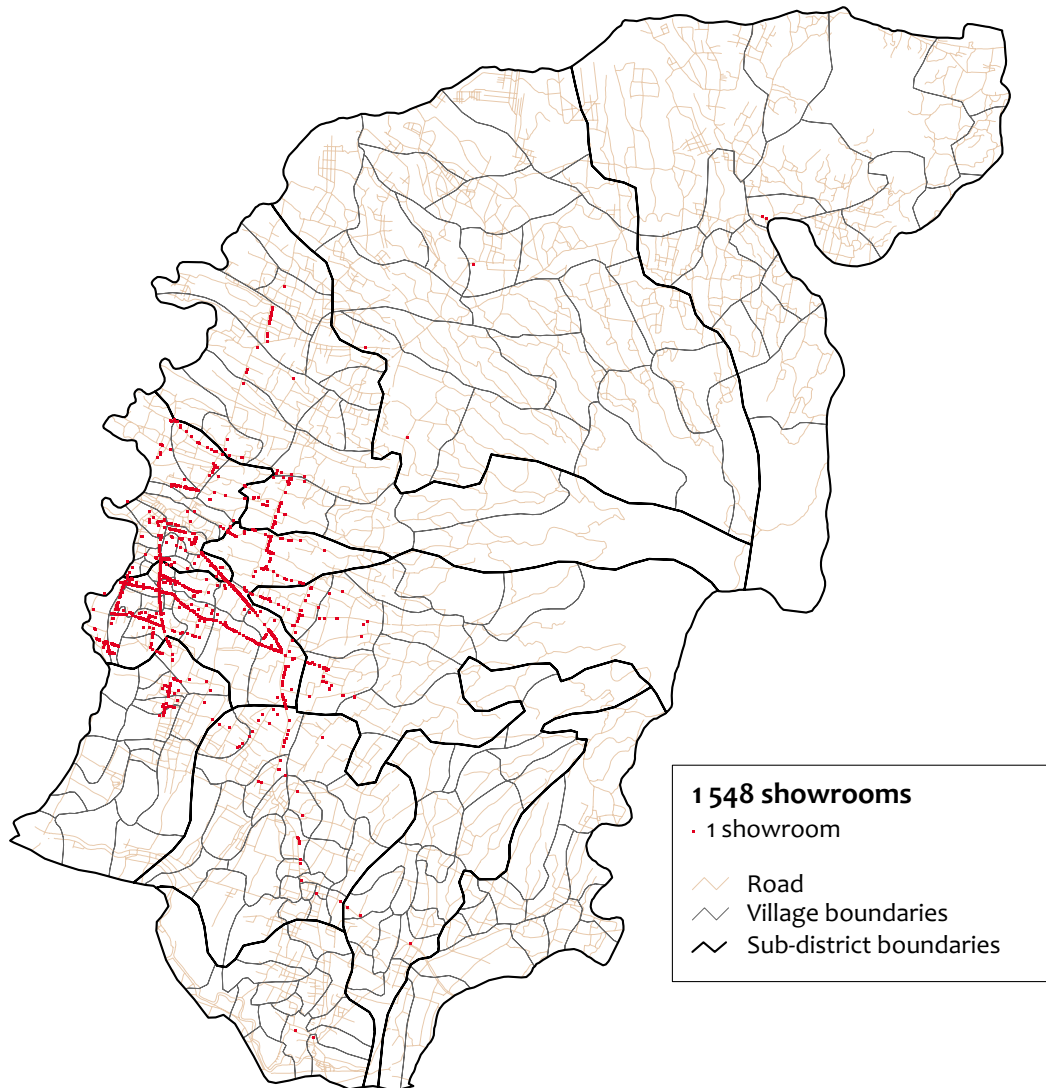
The global pattern of the spatial distribution can be represented as the concentration index of the enterprises over the territory of Jepara (Figure 11). This figure does not show the actual density of the enterprises over the area, but is the product of a mathematical model used to discriminate the trend in density. It clearly shows that the main concentration occurs in the old part of the city.



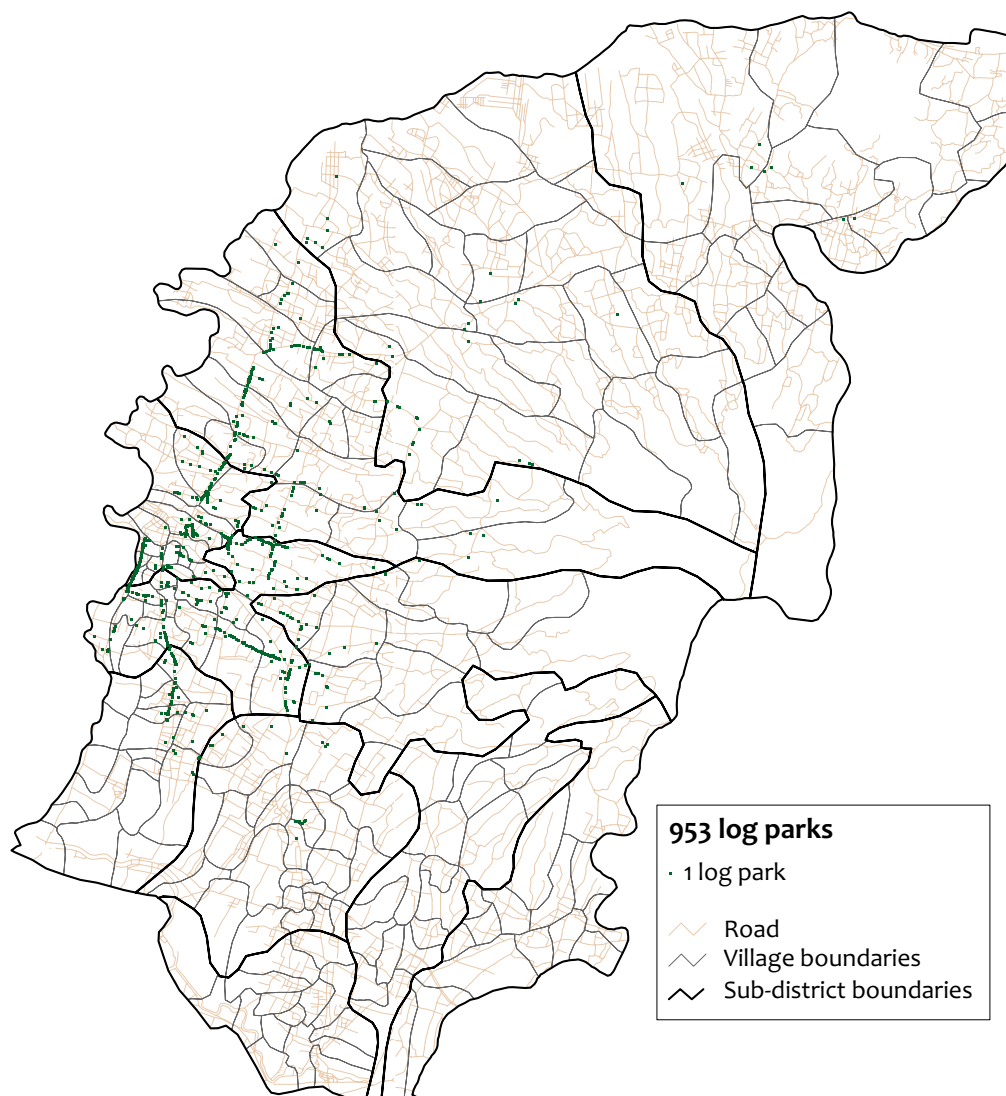
**Figure 4.** Satellite view of Jepara, with location of enterprises described by the database



**Figure 5.** Location of workshops

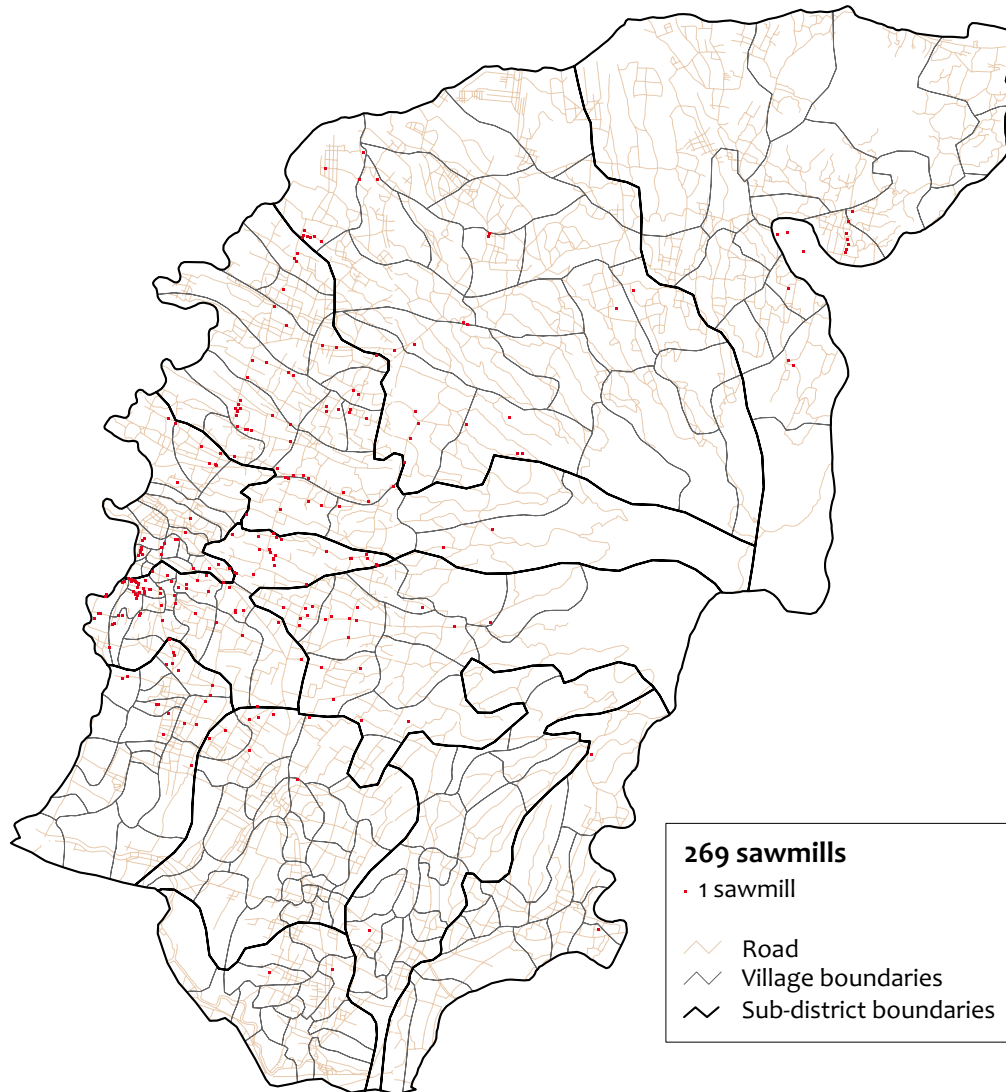


**Figure 6.** Location of showrooms

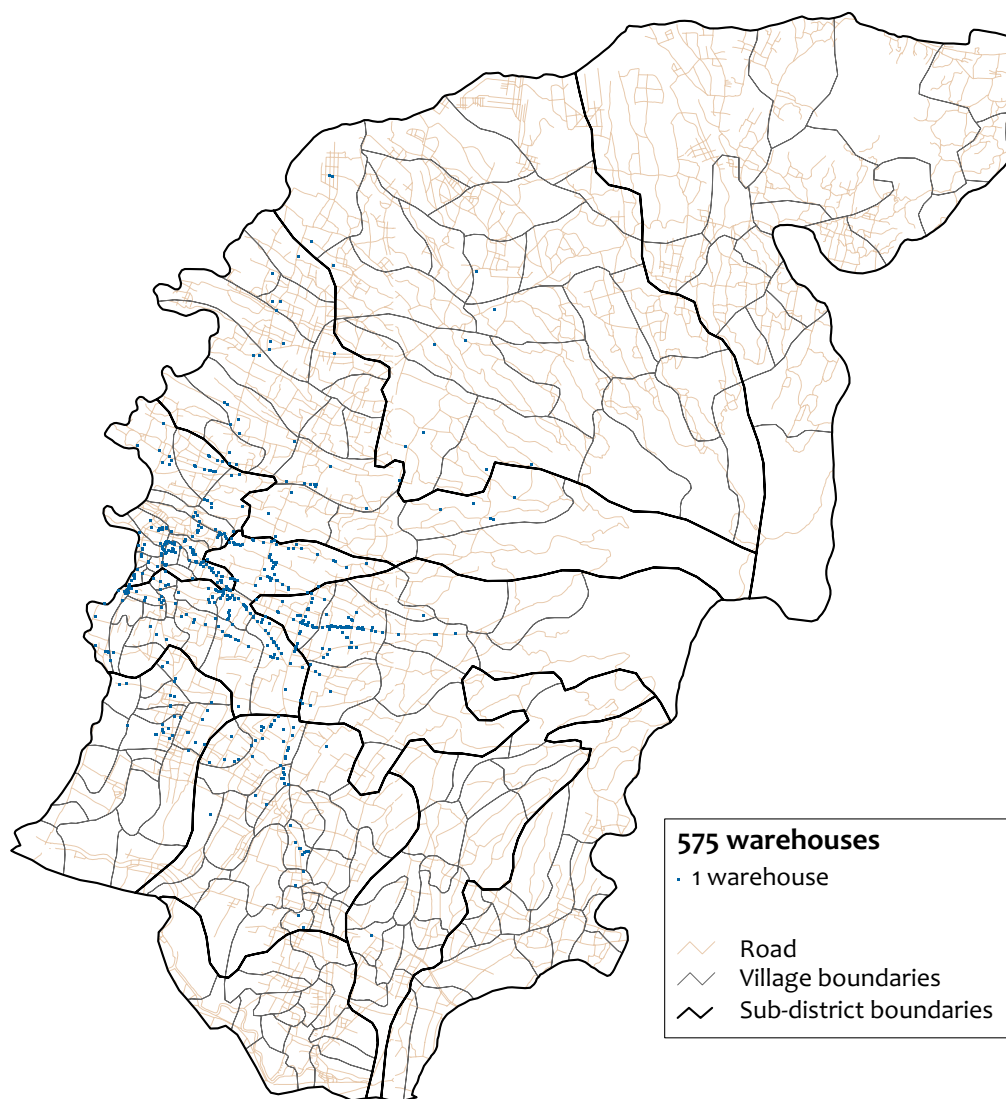


**Figure 7.** Location of log parks

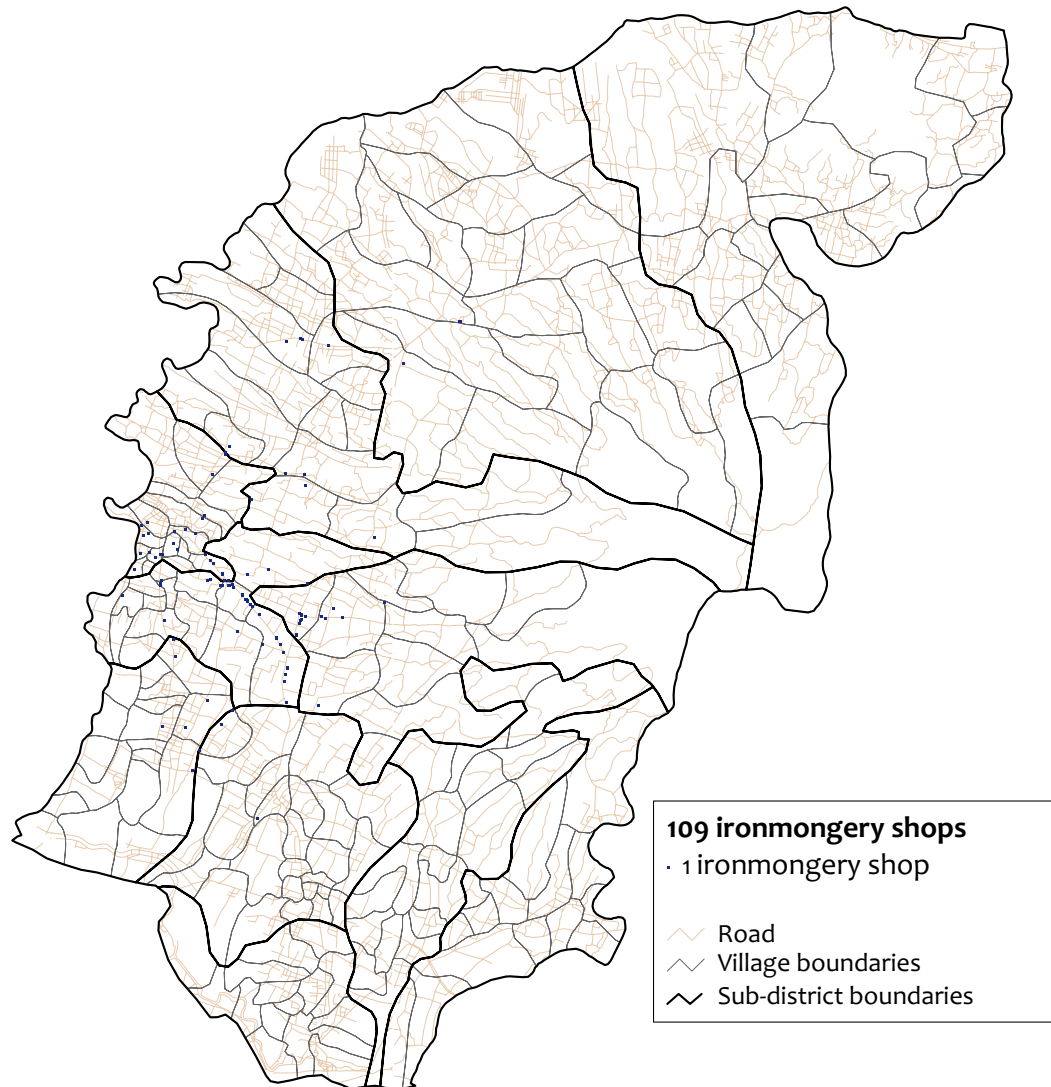




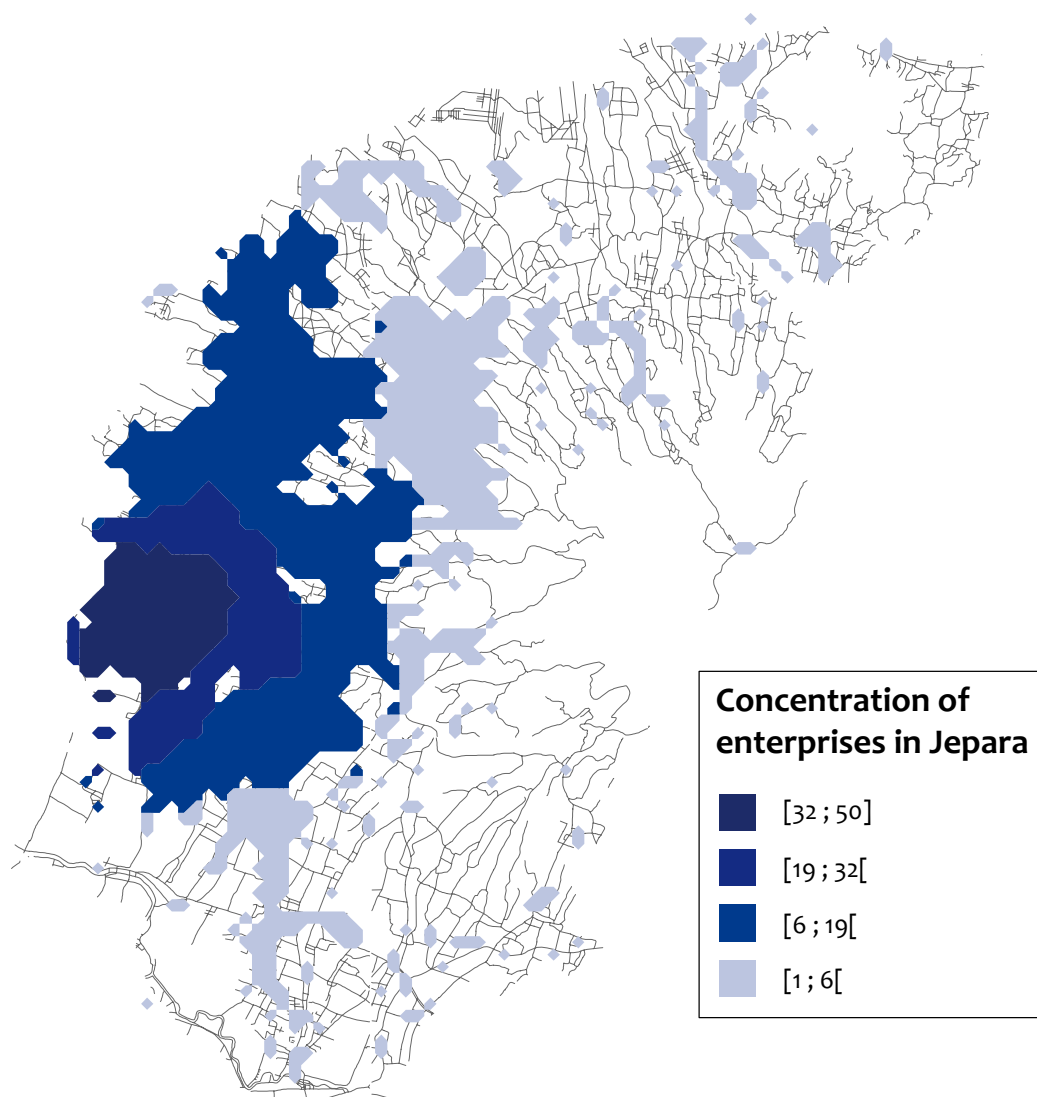
**Figure 8.** Location of sawmills



**Figure 9.** Location of warehouses



**Figure 10.** Location of ironmongery shops



**Figure 11.** Computed concentration index of enterprises in Jepara

## 3.2 The structure of the wood Industry of Jepara, according to the detailed survey by sampling

A total of 958 enterprises (units of all sizes) were analysed in detail. These produced 949 kinds of products, as follows.

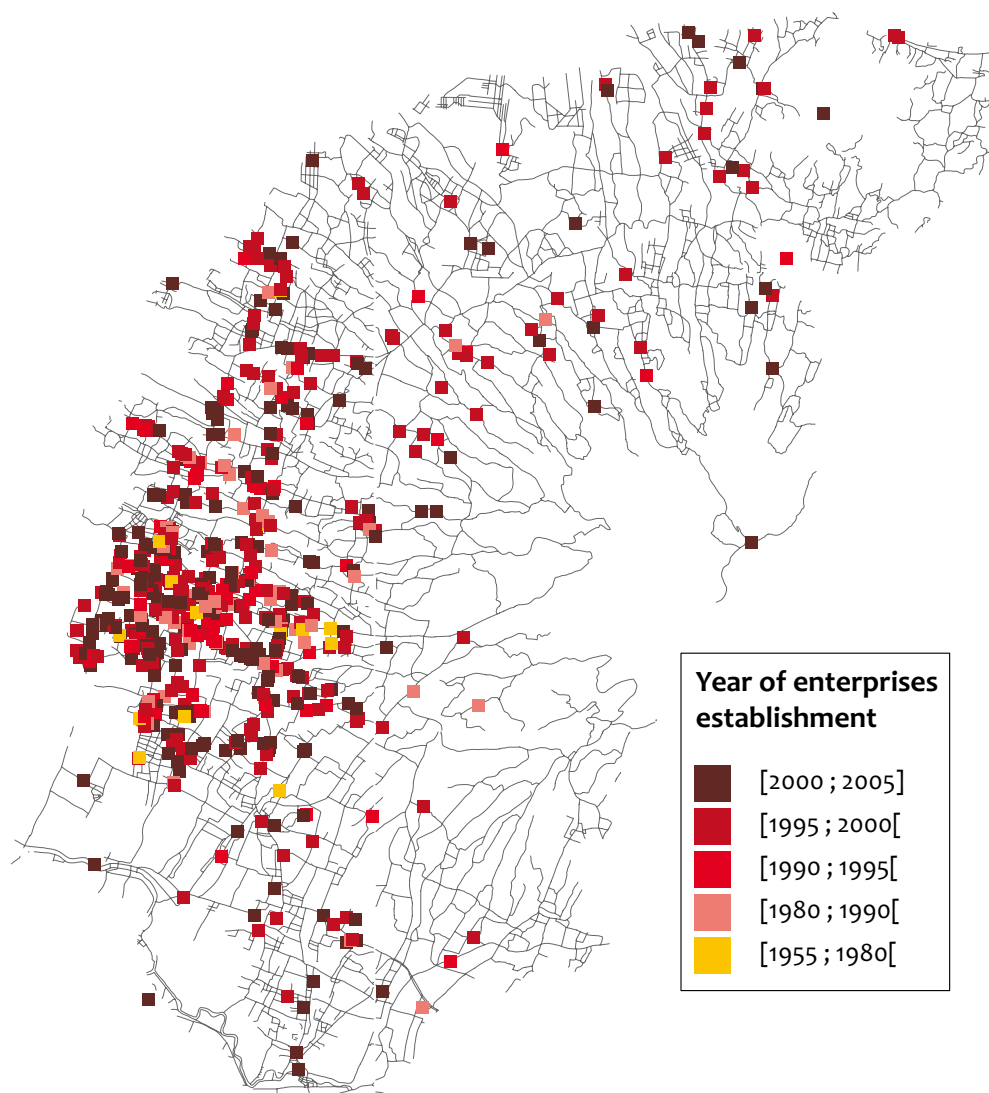
- 7 units produced four kinds of products
- 24 units produced three kinds of products
- 56 units produced two kinds of products
- 862 units produced only one kind of product

Most enterprises deal with a single end product, which indicates the high degree of specialisation of the enterprises in Jepara. The vast majority (95.5%) are enterprises run by a single extended family, while relatively few involved two (4.3%) or three (0.2%) separate families or lineages. Almost all enterprises had at least one other regular partner enterprise, even if there were no links in the ownership of the enterprises. In short, the enterprises in Jepara are highly connected, but this is not primarily through ownership or classical joint ventures, but in other ways, such as pure business linkages.

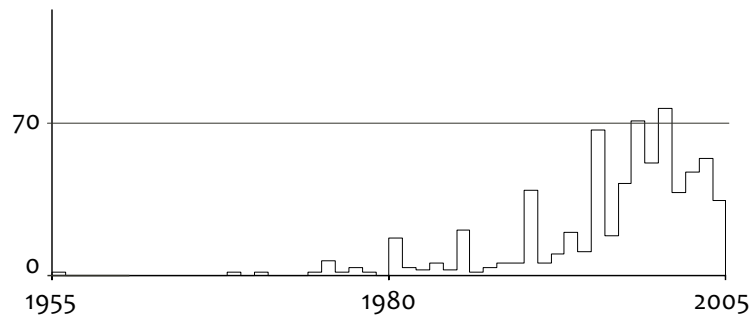
The year of creation of the enterprises is represented for each sampled enterprise, with class intervals 5 years apart and one class for all enterprises set up between 1955 and 1980 (Figure 12). There is no clear spatial trend. The peak of enterprise creation was around year 2000 (Figure 13), with an apparent but not statistically significant decrease from then on. This finding will be confirmed or rejected in the following studies.

## 3.3 Employment generated by the wood industry

A total of 11 276 people (4 092 temporary and 7 184 permanent workers) are employed in the sampled workshops. Extrapolating this to Jepara overall gives a figure of almost 176 470 workers involved in the furniture industry (95% confidence limits: 169 930–183 000, Table 2). The total employment for each Desa (village) is mapped in Figure 14.



**Figure 12.** Year of creation of the enterprises within the sample



**Figure 13.** Creation rate of sampled enterprises from 1955 to 2005

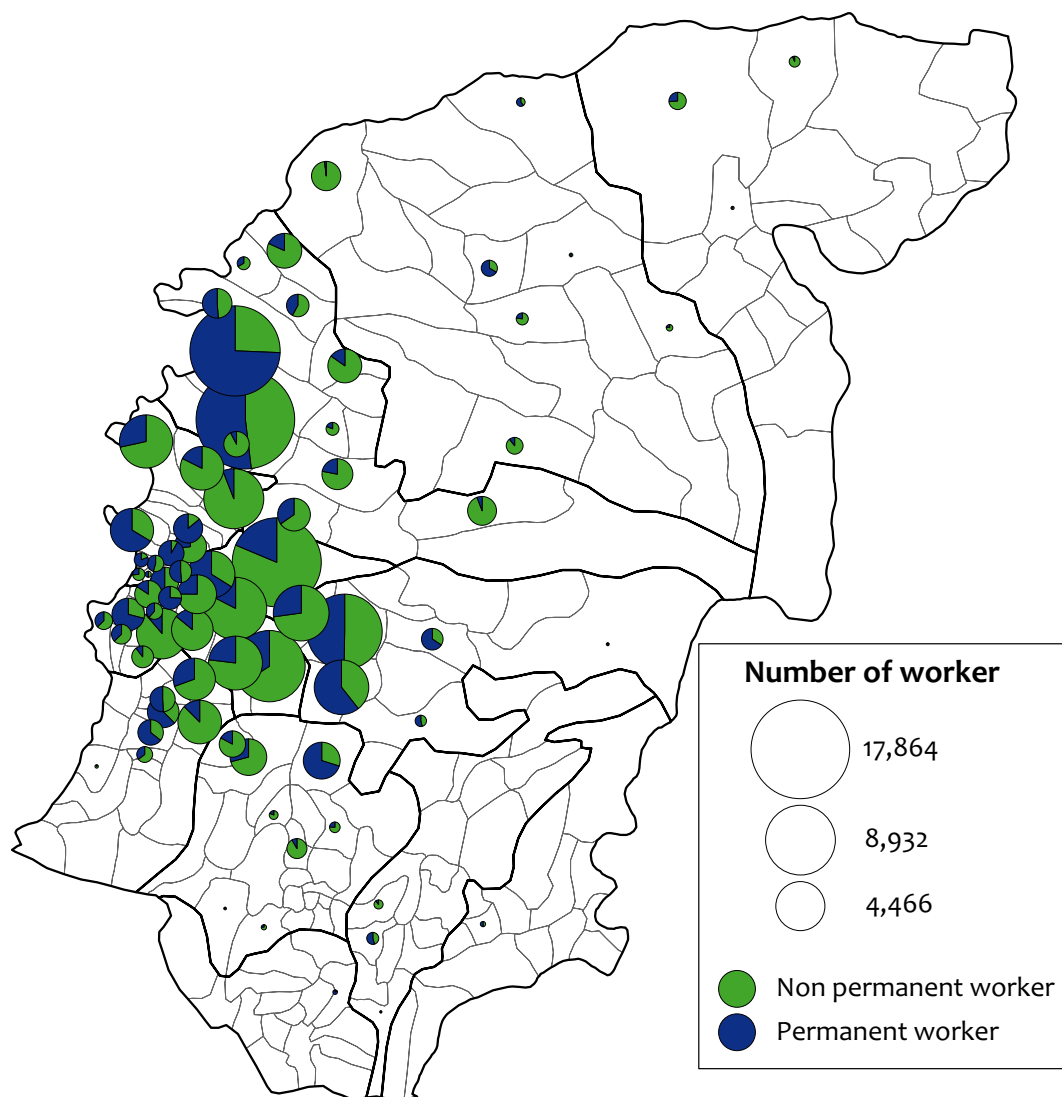
**Table 2.** Structure of employees in the wood industry in Jepara

	Workers	%	Standard Error
Nonpermanent workers	63 462	36	1 619
Permanent workers	113 007	64	1 716
Total	176 469	100	3 335

With the same method described previously in the section 3.1 on ‘The importance of the wood industry in Jepara shown by the extensive’ we found that the existing literature considerably underestimates the employment generated by the wood working industry in Jepara.

The first study (Sulandjari and Rupidara 2003, cited in Posthuma 2003) found 11 568 workers in 2000, which is nine times less than what we found (probably at least 108 000 workers in 2000). Similarly, Sandee *et al.* (2002, cited in Posthuma 2003), found 44 000 workers in 2002, which is three times less than what we found (at least 140 000 workers in 2002). Finally the Indonesian administration (District Office of Industry 2005, cited in Loebis and Schmitz 2005), found 58 210 workers in 2002, or two times less than our findings. Another paper estimates the number of workers for the entire province of Central Java and finds fewer workers than in Jepara itself (Maynard 2004), while there are at least four other important furniture industrial districts within the province, which has 27 locations with noticeable furniture industries.

Based on the sample, most of the enterprises in the Jepara wood industry employ few workers. A limited number of enterprises are large employers, mostly positioned along the main roads (Figure 15). The main concentration of workers is not exactly located in the old city of Jepara,



**Figure 14.** Total employment, per administrative villages



as might be expected from the concentration of enterprises; workers' concentration seems to be linked to the spots with large enterprises (Figure 16).

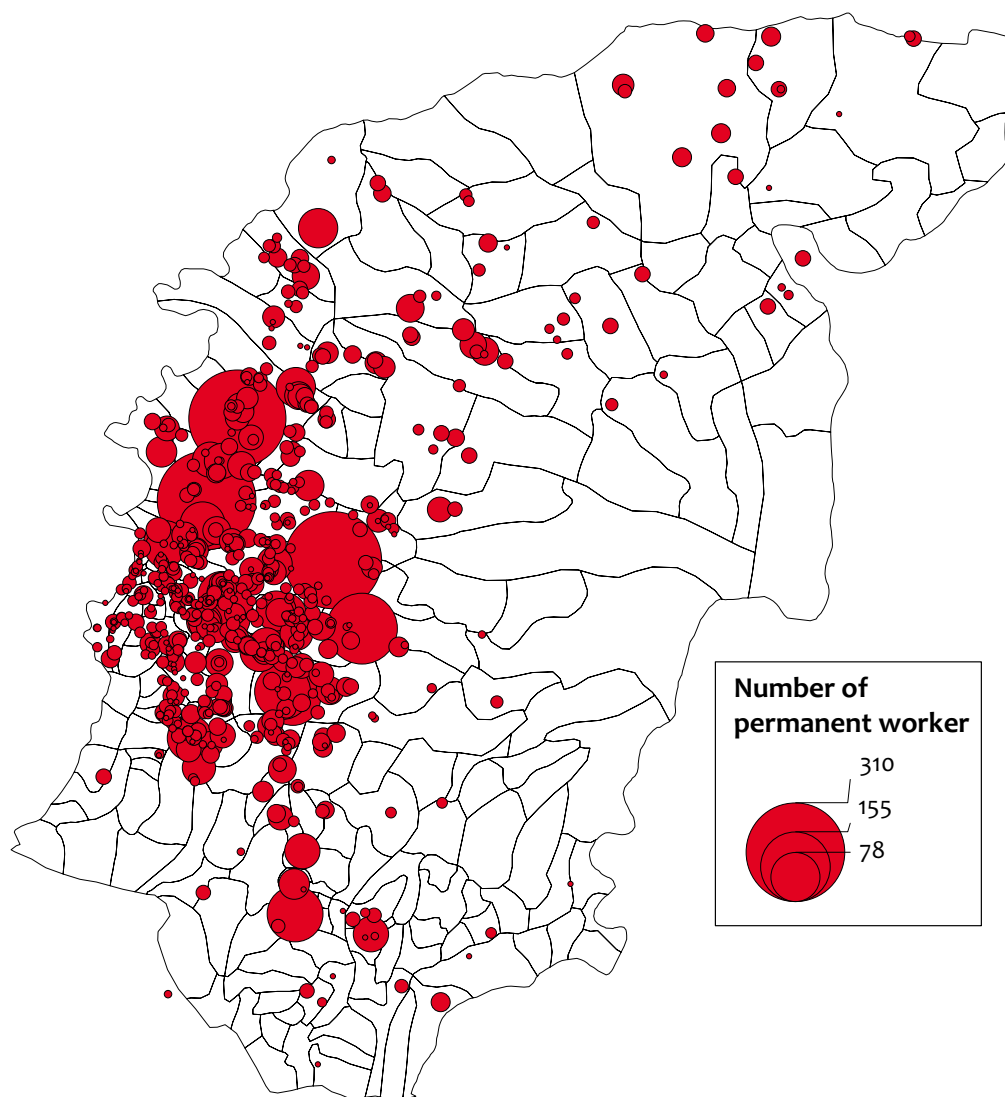
### 3.4 Added value generated by the wood industry

The cash flow declared by the sampled units is 825 billion Rp in sales per year. Extrapolating this figure to Jepara as a whole using the various spatially weighted extrapolation methods (Annex 2) suggests that cash flow of the furniture industry in Jepara is 11 971 – 12 255 billion Rp/year (Figure 17), or about 1 billion euro/year.

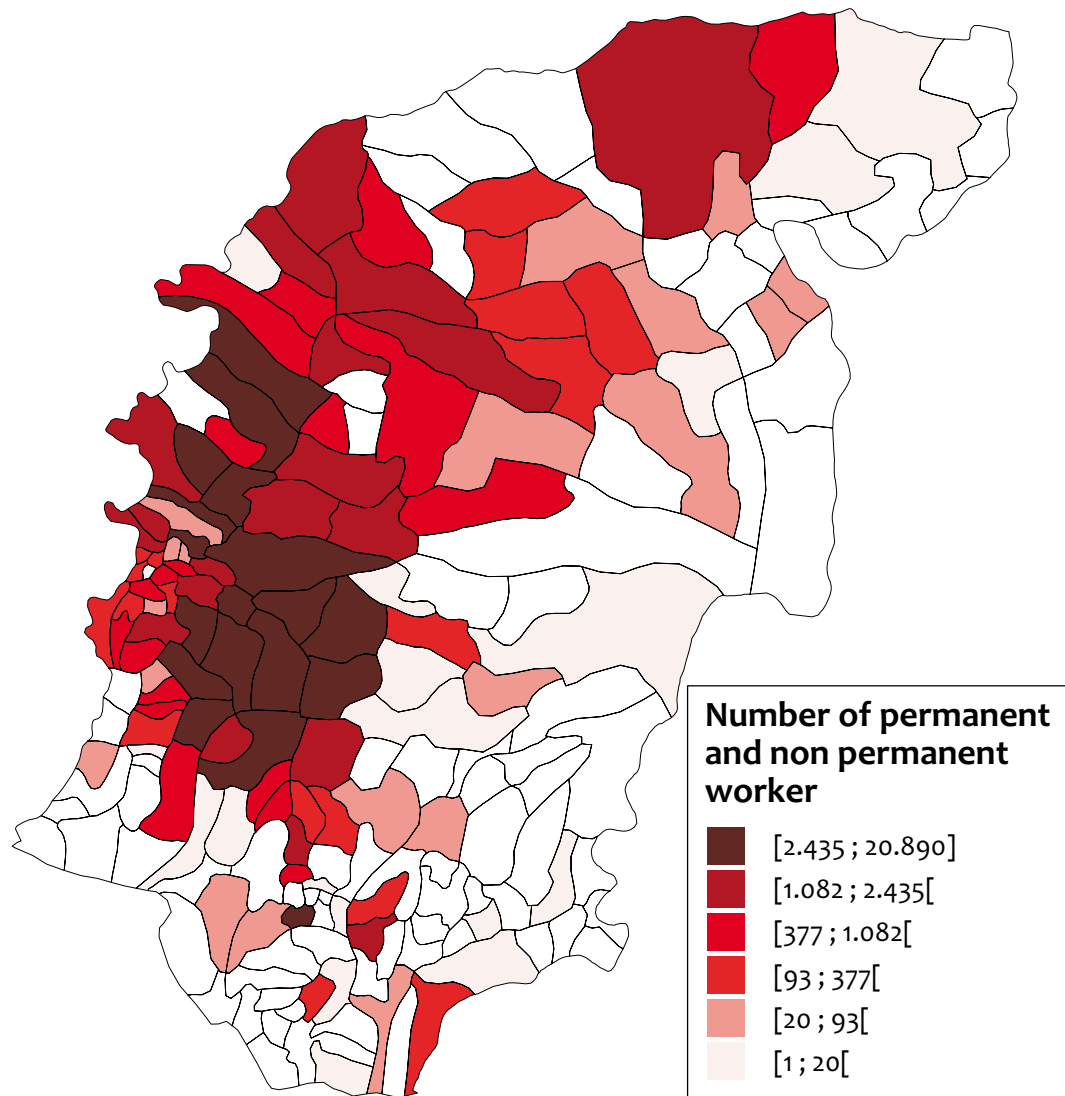
At the Kabupaten level, the average relative cash flow per worker is 74 million Rp (with 95% confidence limits of 70 to 78 million Rp), but the dispersion is high and the spatial heterogeneity among villages is considerable (Figure 18). In some villages, the added value per worker is less than 1 million Rp/year, while others produce more than 600 million Rp/year/worker. There is no clear explanation for the differences, as they are not obviously linked to either the industrial or spatial concentrations. The pattern probably reflects the existence of specialised businesses, scattered across the area. Further investigations are needed on this point, focusing in particular on the proportion of permanent and temporary workers, the nature of the products, and the kind of processing involved in furniture manufacturing.

### 3.5 Roundwood consumption

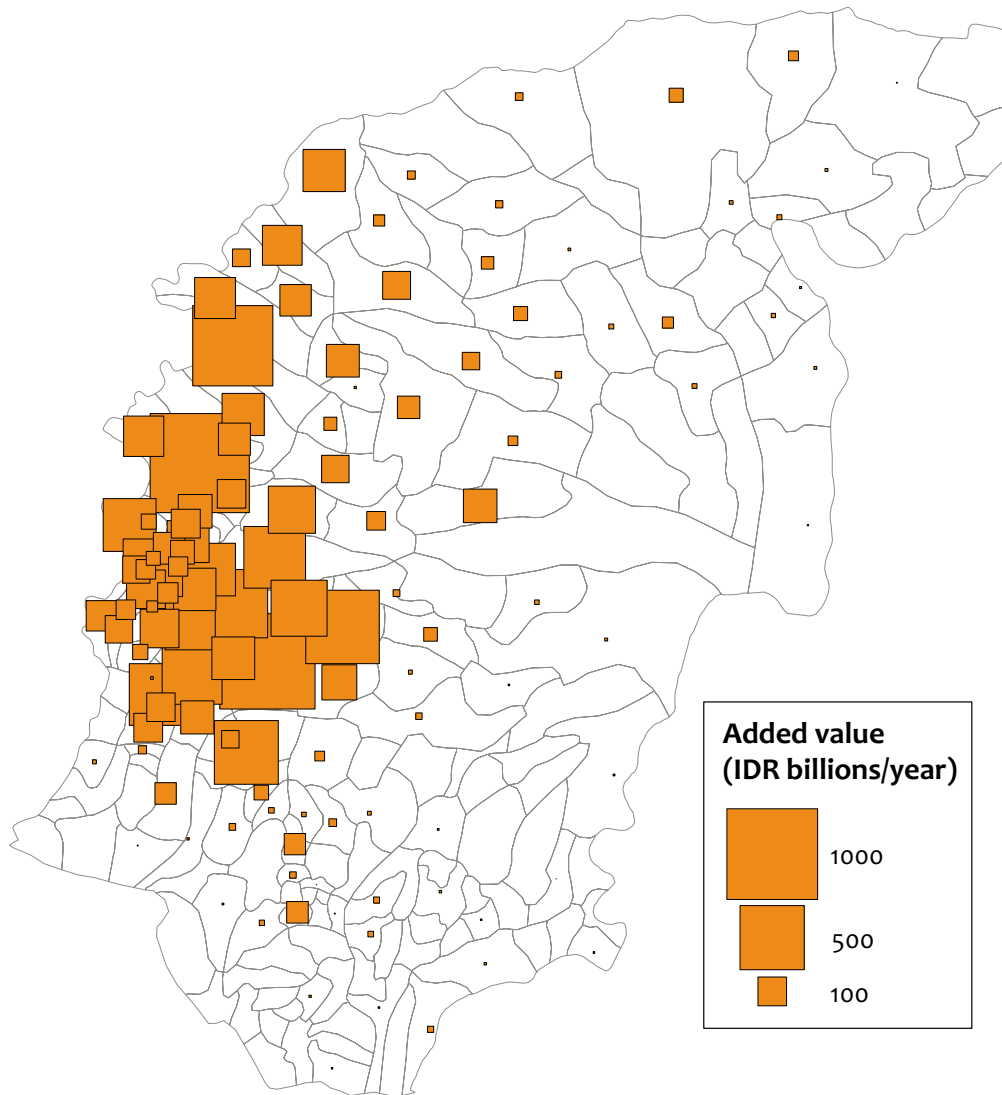
Within the sampled workshops, only 321 enterprises said they had a direct log supply. All the other enterprises bought components, pieces, sets, or even prefinished and finished furniture. The sample therefore consumed 154 353 m<sup>3</sup>/year of roundwood (482 m<sup>3</sup>/year/enterprise).



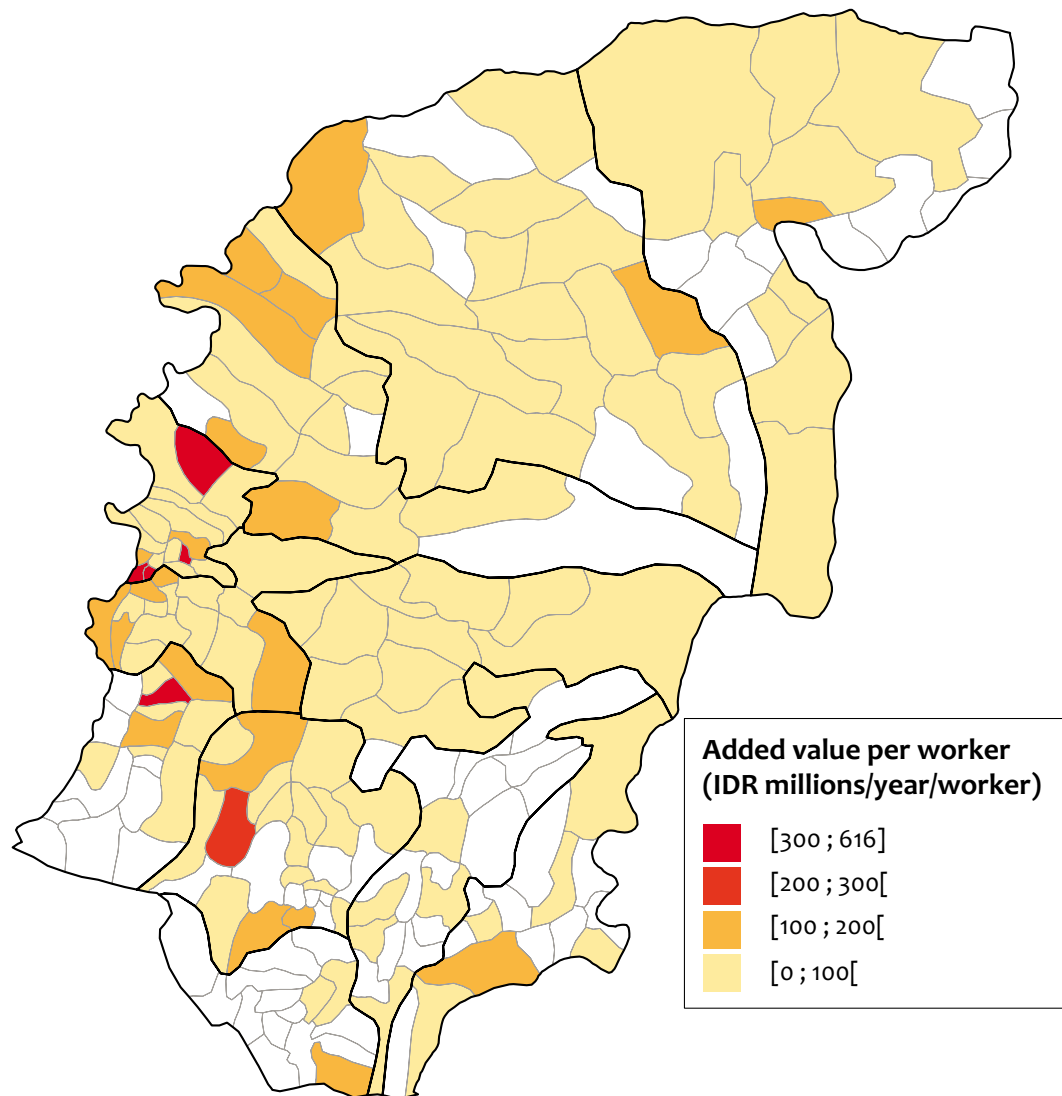
**Figure 15.** Number of permanent workers per enterprise



**Figure 16.** Number of permanent and non permanent workers in each village of Jepara



**Figure 17.** Added value of the furniture industry per village



**Figure 18.** Added value of the furniture industry per worker, for each village

3.5.1 Realistic assessment

Detailed analysis of the roundwood consumption of the sampled industries shows that the local industries can be grouped into two main categories:

- workshops that source their raw material directly from outside Jepara and
- workshops that obtain their raw material indirectly by purchasing it from independent log parks and retailers from within Jepara.

The latter workshops may not have the capital to buy all the necessary logs. They either use loans from their final buyers or obtain their supplies in a large number of small purchases, or do both. These workshops subcontract the initial sawmilling, just after buying the logs, before bringing the processed logs to their workplace. The sawmilling mainly consists of splitting the logs into planks, which are later used in manufacturing the components. The recovery rate in this initial step is about 94.5% (mean calculation based on data provided by three sawmills, sawing respectively 3 110, 576 and 288 m<sup>3</sup> of logs per year).

Given these figures, it is reasonable to assume that there is some double counting of the input declared by the surveyed workshops. The volume of input declared by the log parks probably includes material entering the sawmill under a subcontract before going on to the purchaser as sawn timber. Meantime, the purchaser is declaring the same logs as a purchased input. This hypothesis is supported by the similarity in the annual input volumes declared by log parks and sawmills (61 115 m<sup>3</sup> and 61 497 m<sup>3</sup> respectively).

**Table 3.** Source of logs entering the Jepara wood industry based on a subsample of suppliers

Source of logs	Units	Volume (m <sup>3</sup> /year)	Mean (m <sup>3</sup> /year/enterprise)	Standard deviation (m <sup>3</sup> /year/enterprise)
Outside Jepara	266	43 631	164	396
Log parks and retailers	36	61 115	1 434	3 710
Sawmills	19	61 497	3 237	2 614
Total	321	Not applicable	Not applicable	Not applicable

In this case, the direct roundwood input to Jepara is about 707 000 m<sup>3</sup>/year, and the indirect input, through independent log parks and subcontracting sawmills, is calculated to be about 846 000 m<sup>3</sup>/year. Total input is therefore just over 1.55 million m<sup>3</sup>/year, meaning that within Jepara as a whole, one full-time employee is sustained by 8 to 9 m<sup>3</sup> of roundwood per year.

### 3.5.2 Calculation of the possible, but unlikely maximum

If we first assume that all of the above enterprises get their supply from outside Jepara, the total maximum roundwood consumption of Jepara is estimated to be approximately 2.2 million m<sup>3</sup>/year. For Jepara as a whole, one full-time standard employee is sustained by an average, at most, of 12 to 13 m<sup>3</sup> of roundwood per year. While these numbers are theoretically possible, they are highly unlikely, since a large share of the enterprises do not source their timber directly from outside Jepara, but from retailers within Jepara.

### 3.5.3 Synthesis of the calculation

It is currently impossible to know the actual exact figure for total roundwood inputs to the Jepara wood industries, other than that it must lie between 1.55 and 2.20 million m<sup>3</sup>/year. A full-time employee is therefore sustained by an average of 8 to 13 m<sup>3</sup>/year, with a most probable average value of 9 m<sup>3</sup>/year.

The main processed wood species in Jepara is teak (*Tectona grandis*), followed by mahogany (*Swietenia macrophylla*, locally called mahoni). It is represented in Figure 19, where other species of natural forest are shown in green, while the remaining diverse species, including Acacia, are coloured blue.

Beside the species, it is of interest to discriminate the wood according to its production system: wood grown in state forests versus wood grown in villages. In the case of teak or mahogany, the wood sourced from the villages is also known as *jati kampung*, or *mahoni kampung*. The use of these various categories is illustrated in Figure 20. Enterprises that mostly use teak from villages are shown in blue, while enterprises using teak from state plantations are coloured green. Yellow and red colours represent enterprises processing species other than teak. The size of the circles is proportional to the total number of workers within enterprises.

The geographical source of the wood is mainly Java, with an increasing share coming from the outer islands, according to the traders surveyed. The presence of a large number of traders and brokers installed in Jepara in order to supply the local market, as well as the specific nature of contracting and subcontracting relationships between the enterprises, creates an excessive amount of wood sourced in Jepara itself. Figure 21 represents the geographical sources of the wood. The colours of the sectors correspond to the place of origin of the wood used in each enterprise. The size of the circles is proportional to the number of workers in the enterprise at that point.

## 3.6 Production analysis

### 3.6.1 Sawmills

The 269 sawmills of Jepara mainly process the logs into simple planks, and do not transform the material any further. (The workshops directly process the pieces and furniture components out of these planks. Thus the recovery rate of the sawmills is high. According to the data provided by three sawmills of various sizes the average recovery rate is 94.5% (see 3.5.1).

### 3.6.2 Relationships between workshops

Out of the sample of 955 different enterprises, 21% consist of several units linked to one owner. This suggests a very dense and intricate web of relationships among units, not taking account of a network based on kinship, probably more intricate.

**Table 4.** Number of owners possessing more than one enterprise

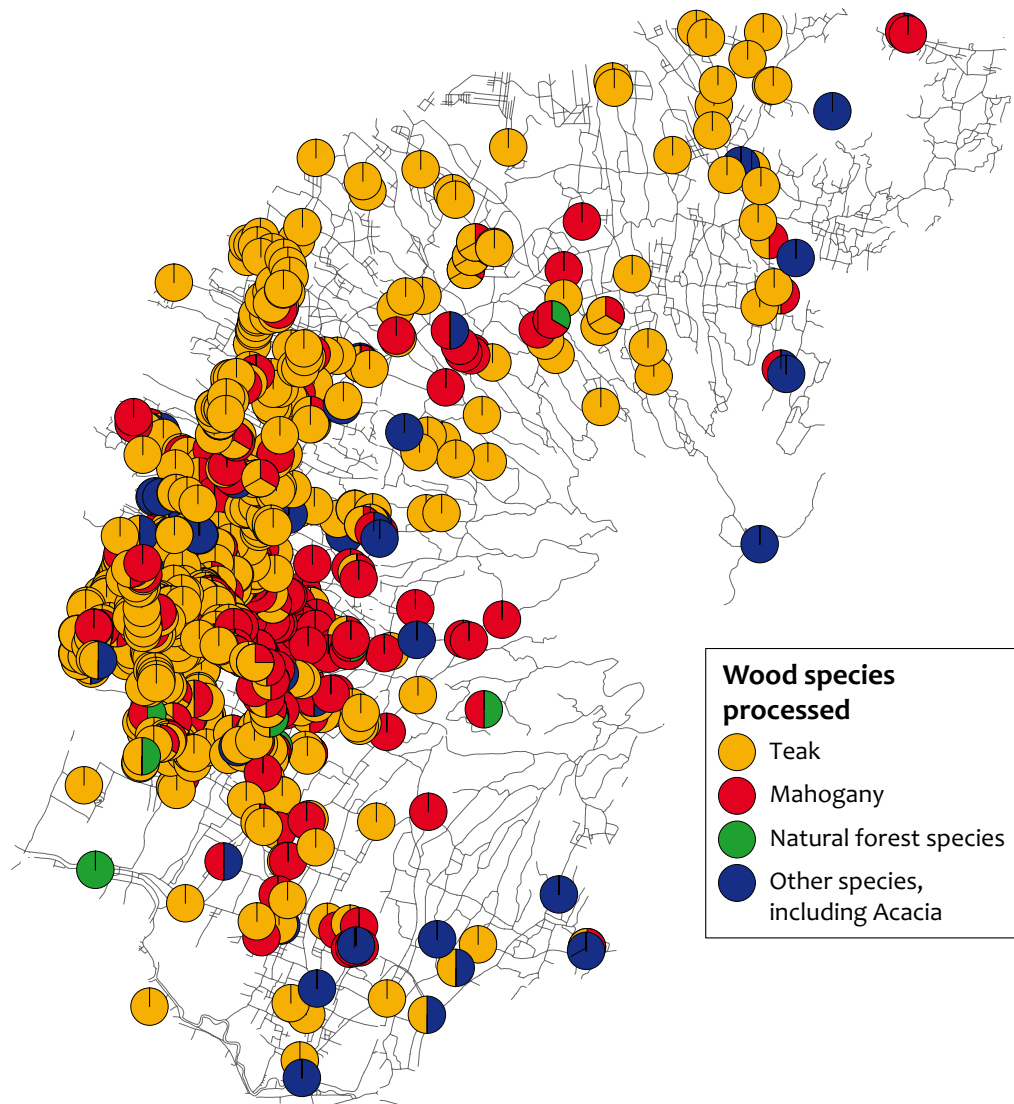
Number of enterprises per owner	Number of cases	Percent of all enterprises
11	1	1
10	1	1
8	1	1
7	3	2
5	5	3
4	6	3
3	8	3
2	40	8
Total	65	21

The high level of division of the process steps among enterprises is reflected in the 78% of workshops that report they work in close relationship with partners.

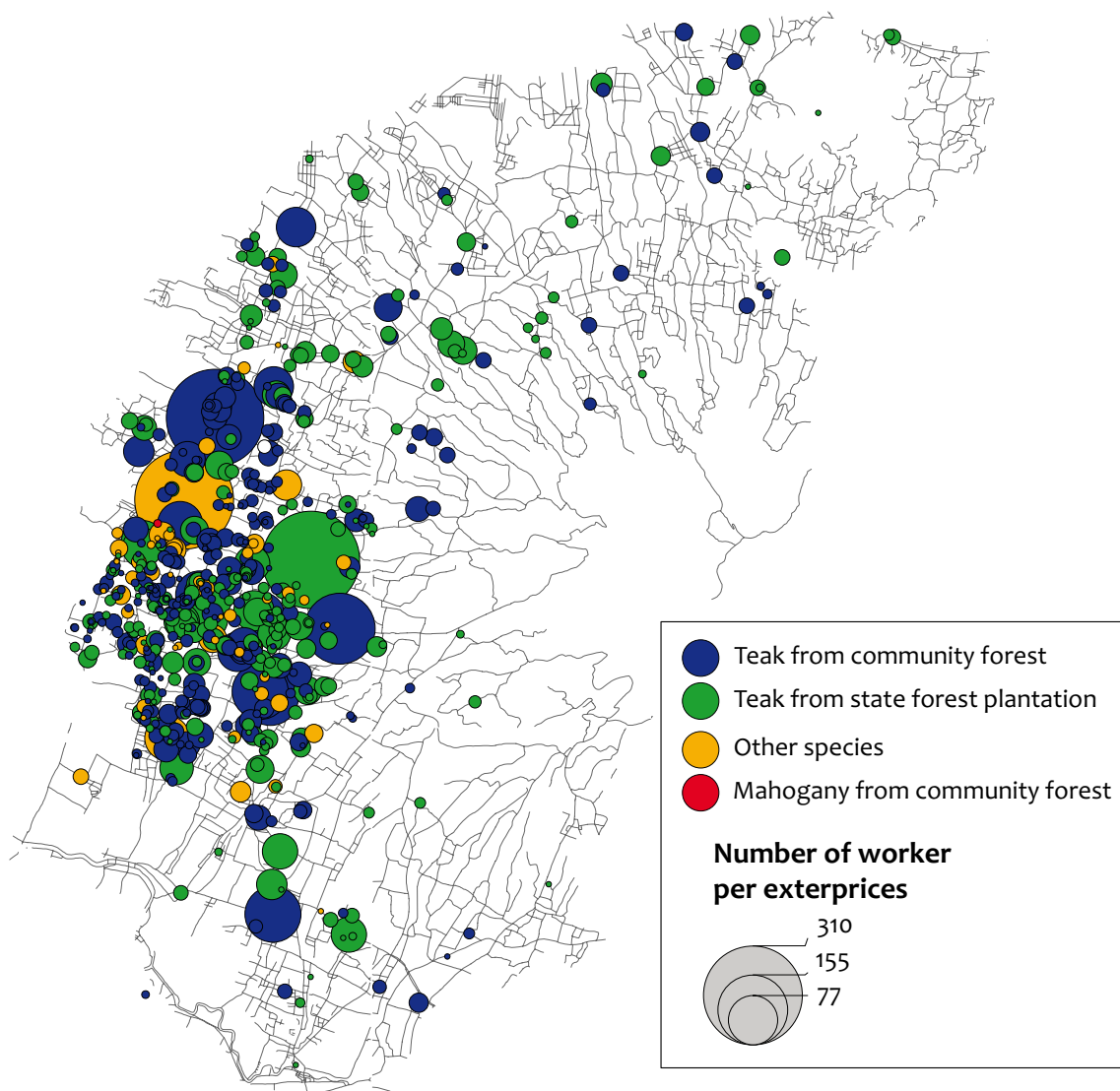
**Table 5.** Number of enterprises specifying links to regular partners

Number of partners	Number of enterprises	%
1	723	76
2	18	2
Total	741	78

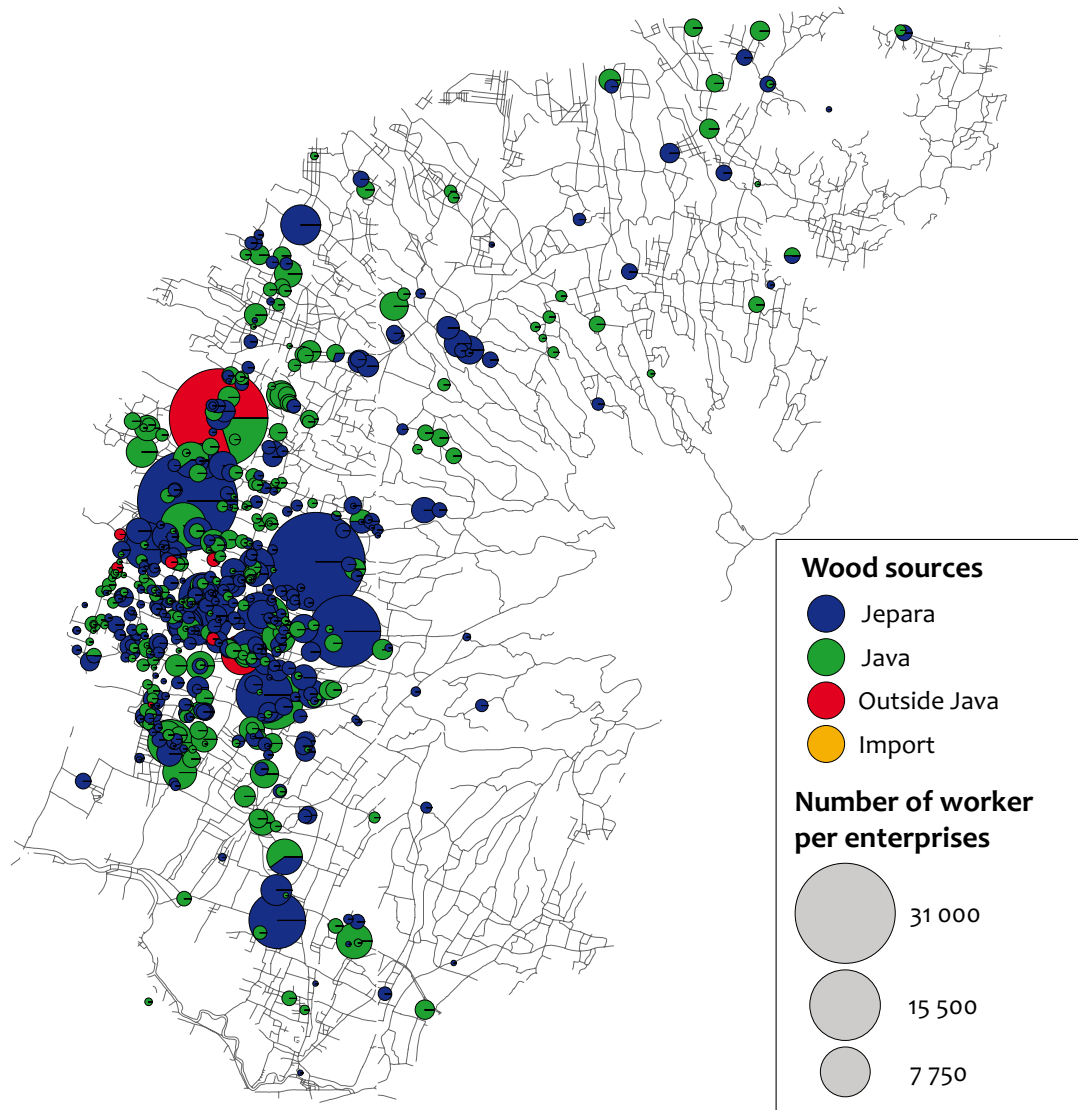




**Figure 19.** Main wood species processed in Jepara



**Figure 20.** Use of wood according to its production system



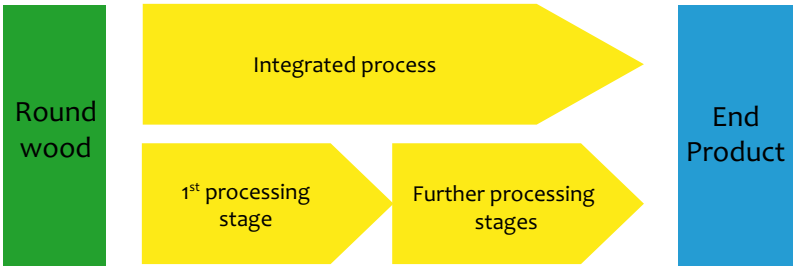
**Figure 21.** Source of the wood used in each enterprise

3.6.3 Structure of production

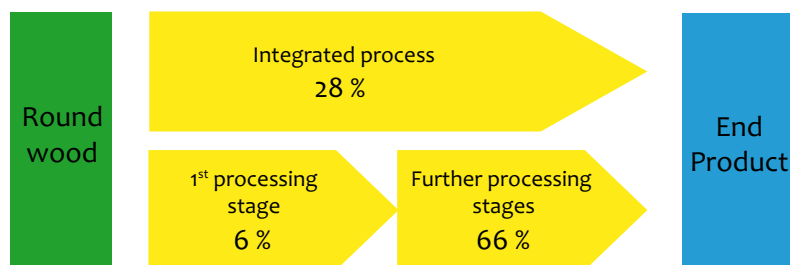
The enterprises of Jepara can be categorised into three groups. The first consists of integrated enterprises, which produce essentially finished or prefinished products from an input of unprocessed roundwood. The second group comprises those enterprises (log parks and sawmills) that specialise in initial processing of the raw material to produce simple sawn timber for the third group. The third group is made up of workshops in which the input comprises sawn timber and various components, pieces, and sets of products at different stages of manufacture, which are then assembled into a finished product.

**Table 6.** Structure of the wood processing industry in Jepara expressed as percentage of the total number of enterprises

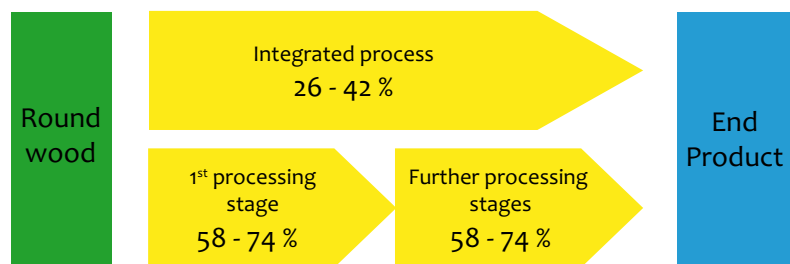
	% of total
Integrated process	28
First processing stage	6
Further processing stages	66
Total	100



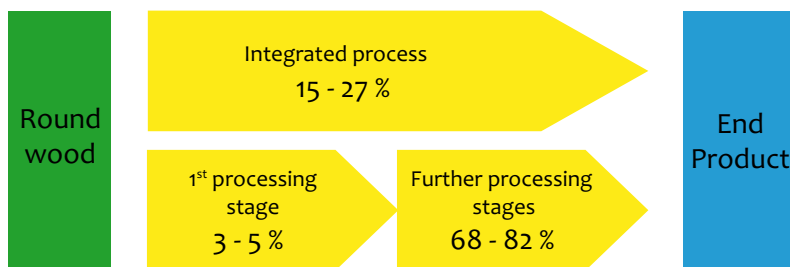
**Figure 22.** Analytical structure of the production in Jepara



**Figure 23.** Structure of the production in Jepara, in percent of the total number of enterprises, with respect to the error margin



**Figure 24.** Structure of the production in Jepara, in percent of the volume (roundwood equivalent), with respect to the error margin



**Figure 25.** Structure of the production in Jepara, in percent of the total employment, with respect to the error margin

### 3 RESULTS AND DISCUSSION

Structure of the production in Jepara, in percent of the volume (roundwood equivalent), with respect to the error margin

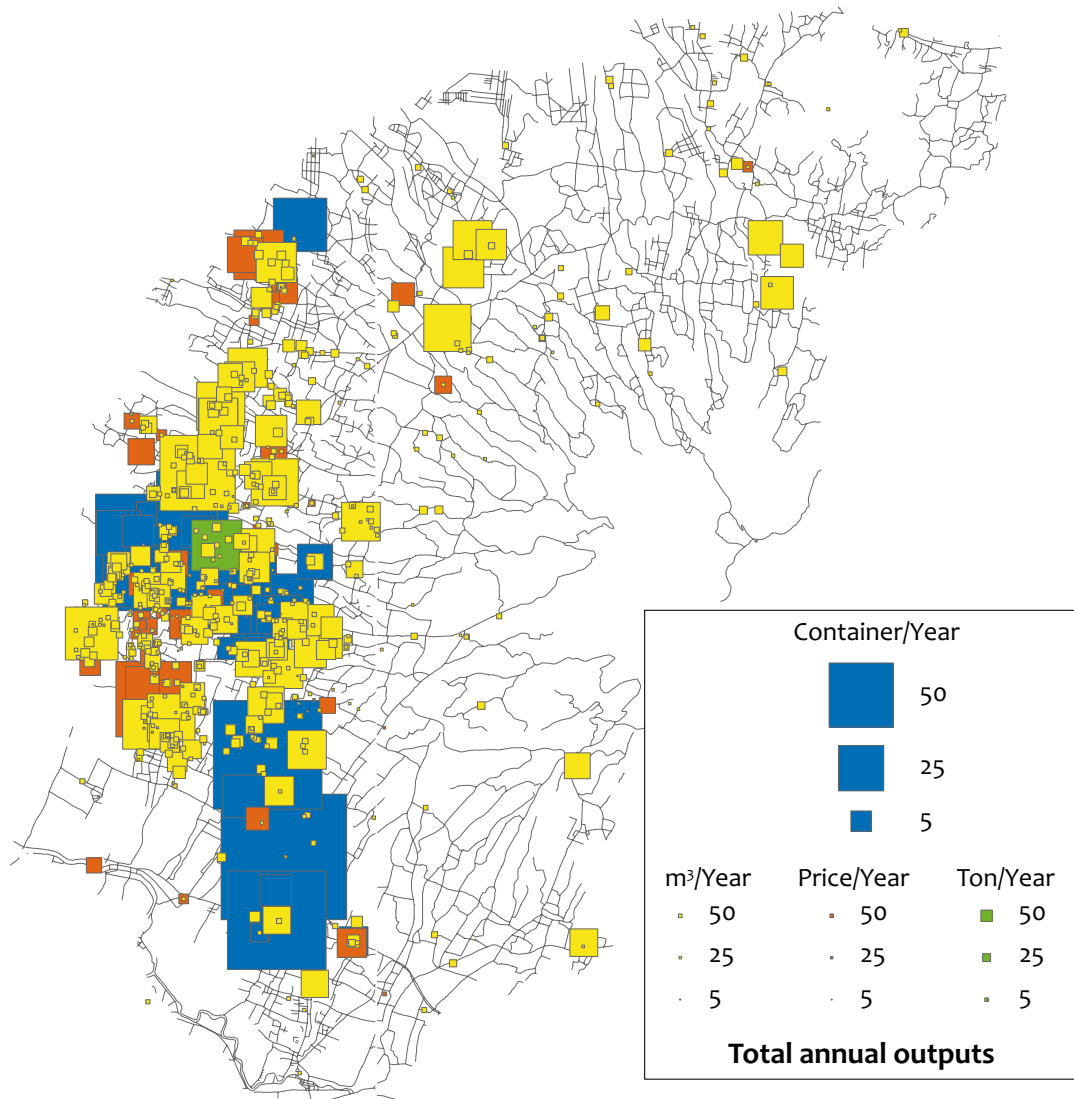
	Error margin %	Possible value %
Integrated process	26 to 42	34
First processing stage and further processing stages	58 to 74	66
Total		100

**Table 7.** Structure of the production in Jepara showing percent of the total employees, with respect to the error margin

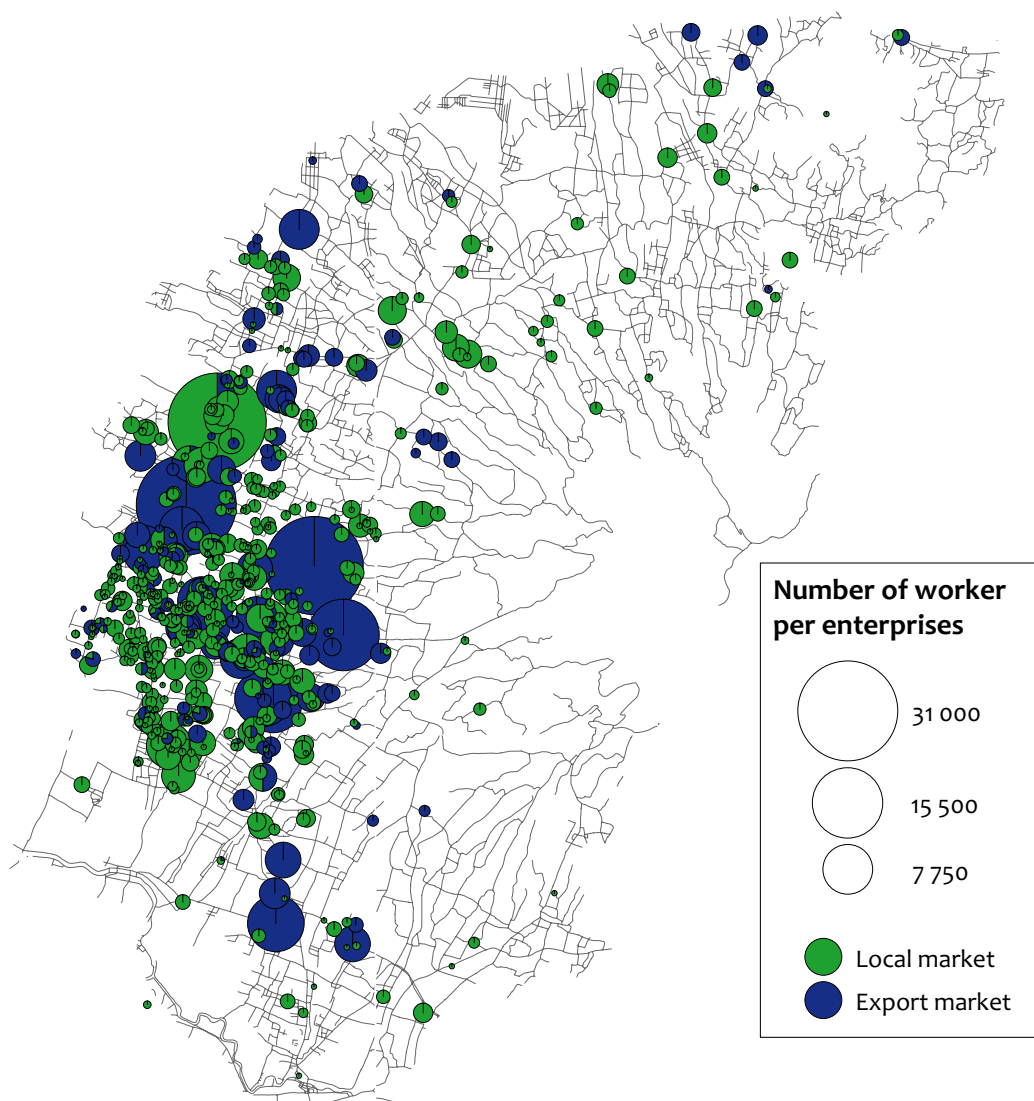
	Permanent employment		Temporary employment		% of total
	Workers	%	Workers	%	
Integrated process	2 213	27	674	15	23
First processing stage	385	5	151	3	4
Further processing stages	5 538	68	3 671	82	73
Total of the sample	8 136	100	4 496	100	100
<b>Total extrapolated to whole Jepara</b>					
Integrated process	30 000		9 000		
First processing stage	5 000		2 000		
Further processing stages	80 000		51 000		
Extrapolated total	115 000		62 000		

Enterprises that produce mostly finished furniture actually express their outputs in containers and tons. They seem to favour locations along the main road. Enterprises that express their outputs in cubic metres or pieces are mainly producing components for the Jepara market. This is represented in Figure 26.

Since the 1970s, a large share of Jepara's furniture production has gone towards satisfying local demand (Posthuma 2003). Later, exports became more prominent and probably culminated between 1998 and 2002. According to some comments recorded during the survey, it seems that this export trend is declining while the share of domestic sales is rising to meet the demand of the growing Indonesian urban and/or middle class. The main final furniture markets are represented in Figure 27 and Figure 28. The colours of the circles correspond to the markets of the enterprises, and the size of a circle is proportional to the total number of workers in the enterprise. The number of enterprises that sell to the Jepara market itself actually points out the high level of subcontracting activities, which reflects the specificity of industrial district organisation.

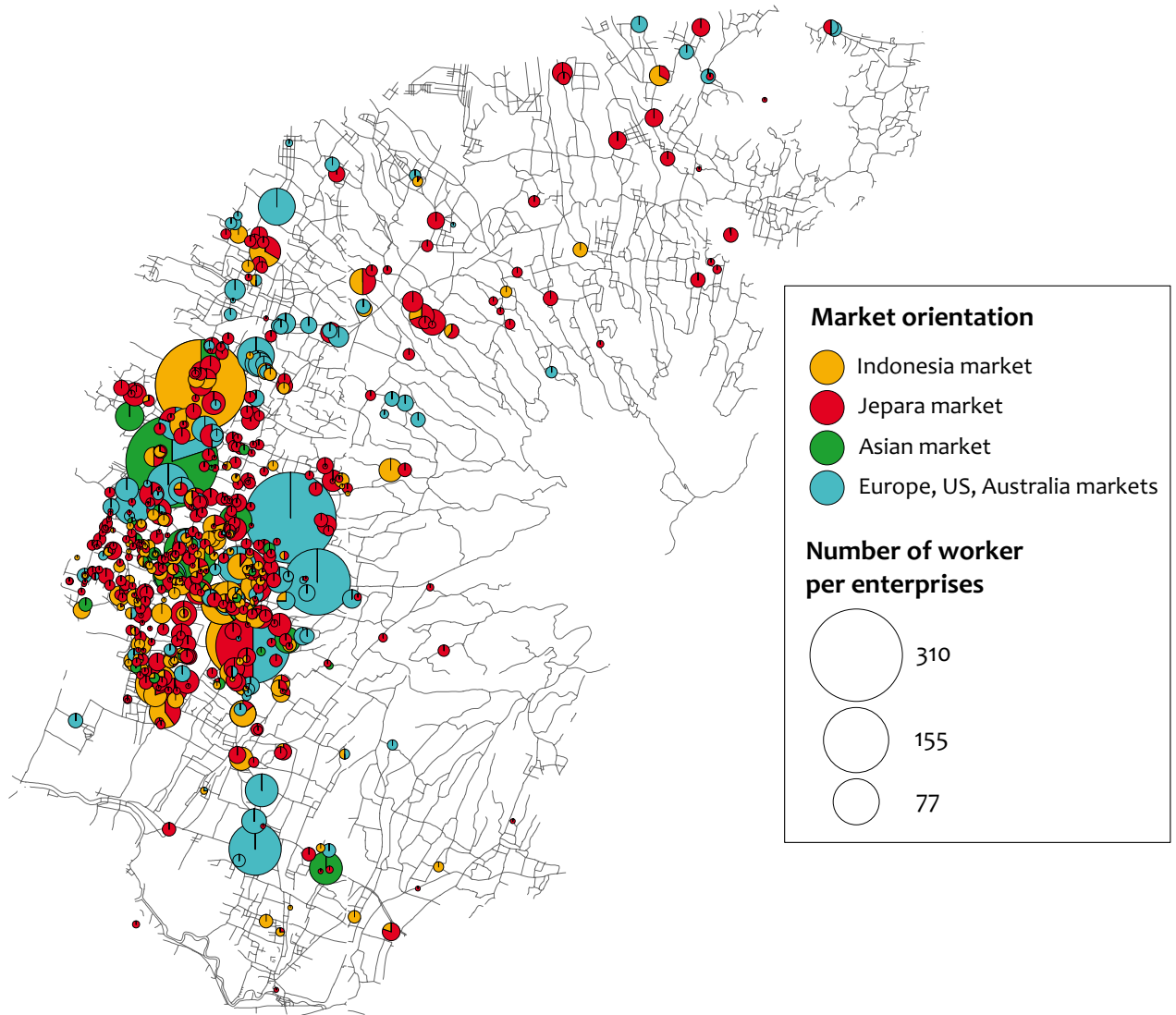


**Figure 26.** How the enterprises of Jepara quantify their outputs (containers, pieces, tons and m³)



**Figure 27.** Orientation of production towards export or local markets





**Figure 28.** Detailed orientation of production towards export or local markets



# 4 CONCLUSION

This work is among the few existing industrial district surveys that combine economic, sociological and industrial analysis.

We found that 9 m<sup>3</sup> of roundwood per year sustains one full-time job in an operation with the kind of structures addressed in the preceding pages. As a well-managed teak plantation in Java produces 9 m<sup>3</sup>/ha/year minimum (Von Wulffing 1931), this result means 1 ha of forest plantations should sustain one job in the furniture industry for 12 months. Given this, if the state-owned forest company Perum Perhutani—with its 3 million ha in Java—devoted 1 million ha to teak or mahogany forest plantations, then 1 million people could have their jobs secured through the furniture industry.

Previous studies underestimated the size of Jepara's furniture industry. Our results show that the size of the Jepara industry was underestimated 2 to 9 times. There are several reasons for this:

First stands the high level of informality of the industry. Home industries provide most of the jobs and many previous surveys overlooked them. The limited accuracy of official figures was stressed by Alexander and Alexander (2000), who calculated that these figures probably underestimated reality by one third, as they did not encompass the informal home industry. By comparing the ratio of workers per enterprise, we noticed that some former studies missed not only the small companies but also many of the big ones. This is certainly true for the official figures, where we found similar proportions with our results. Many surveys were simply missing so many enterprises of different sizes simply because they remained unseen behind or inside habitations, restaurants, showrooms and other establishments. This is a problem of method.

## 4 CONCLUSION

The lack of adequate methods may also explain why current figures underestimate the true figure. Our method is able to take into account all sizes of enterprises because of our accurate samples and our capacity to reach a more realistic figure by extrapolating from the sample. The main innovations of our method are the links between the data and the spatial patch through GPS tools and the design of the sampling according to spatial heterogeneity. This approach minimizes the flaws mentioned above.

We also found that Jepara consumes more wood (1.5 to 2.2 millions m<sup>3</sup>) than the official production of State Forestry Department for all Java (923 632 m<sup>3</sup> in 2004) (Departemen Kehutanan Republik Indonesia 2004<sup>8</sup>). In addition, Jepara is one among many industrial districts that produce furniture in Java. This aspect raises fundamental questions about the role of agroforestry in Java.

All this suggests a new hypothesis: agroforestry's contribution to wood supplies for the furniture industry is probably much higher than suspected, even though part of this supply may also be derived from illegal timber sources on Java as well from East Indonesia islands. Nevertheless, our results suggest that all the policy decisions or analysis based on these former studies could have been seriously misinformed by the magnitude of the underestimations.

Besides the first results and first analysis, there is still much that is unknown about Jepara. Firstly, the society in Jepara is deeply rooted in rural Java and has strong social links between city entrepreneurs and farmers or wood producers from numerous village plantations. Because all the wood for the industry comes from outside the city, we still need to understand the nature of these links, the ways they are structured and the social systems in wood-producing villages.

To achieve this it would be useful to extend the study outside Jepara, to those areas where the wood originates. The principles of the FPN method could be used in this context (Roda 2004; Roda and Cadène 2005). Among those places identified by our Jepara survey, a representative subsample of villages could be selected. These villages and places could then be visited and surveyed. The production system is highly dynamic. Doing a follow-up survey, one or several years after the first survey, would allow the dynamics of this system to be properly measured.

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# ENDNOTES

<sup>1</sup> Industrial districts can be defined as networks of mostly small and specialized firms which are located in close proximity and are embedded in local social structures supporting a mix of cooperation and competition [(Marshall 1890;Piore et al. 1984;Humphrey 1995;Cadène et al. 1998;Humphrey et al. 2001)].

<sup>2</sup> There are 3597 enterprises according to administrative district statistics (Pemerintah Kabupaten Jepara, 2004), but there also are many ‘unregistered’ enterprises, and the administrative district expects the real number to be as high as 5000. Our survey has demonstrated that the reality is far beyond that.

<sup>3</sup> Essentially teak wood, harvested either from state plantations or, more recently, from village plantations.

<sup>4</sup> Adi Nugroho, Budi Suprojo, Desti Wahyu Kurniawati, Dewi Azizah, Eko Agus Wibisono, Fajar Hery Purwanto, Fauziatul Iffah, Iwan Achmad Ambiya, Muhammad Maksalmina, Rini Puspita Sari, Wachid Nurhadi, and Wuri Rahmawati.

<sup>5</sup> Achmad Uzair and Maya Dina.

<sup>6</sup> Small = 1 to 10 workers; Medium = 20 to 100 workers; Large = more than 100 workers

## ENDNOTES

<sup>7</sup> In this paper we do not discuss the matters of education and wealth of people. Data concerning these aspects are not yet analyzed.

<sup>8</sup> The CEMSED study has quantified the consumption of Java Central as 1.8 millions m<sup>3</sup>/year (Sulandjari and Rupidara 2003), which is a dramatic underestimation compared to our results for Jepara.



# ANNEXES

## Annex 1: Calculating the optimal size of squares

The general formula for calculating the optimal size of the squares, using standard interpolation with weighted distance to all other points where there is furniture manufacturing, is:

$$V_k = \frac{\sum_{i=1}^m \frac{V_i}{d_{ik}^3}}{\sum_{i=1}^m \frac{1}{d_{ik}^3}}$$

where

- $V_k$  is the value of the grid square k,
- $V_i$  is the value of  $P_i$  (here, one dot  $i = 1$ )
- $P_i$  is the dot number  $i$  (one point with one furniture manufacturing activity)
- $V_p$  is the value of the  $P_i$  which is the closest to the centroid of the square k
- $d_{ik}$  is the distance between all  $P_i$  and the centroid of square k
- $m$  is the number of  $P_i$  within the square k

## Annex 2: Sampling and extrapolation methods

Given the difference in size of the large and smaller grids, where each large grid contains a variable number of smaller grids, we calculated the number of workshops in each category to be visited as follows.

Denote  $1/n$  as the proportion to be sampled, denote  $M$  as the number of workshops in the optimized square  $K$ , and denote  $m$  as the number of workshops in the fine square  $L$ :

- the number of workshop to be visited in square  $K$  is:

$$\frac{1}{n} \cdot M$$

- as well, the number of workshop to be visited in the fine square  $L$  is:

$$\frac{1}{n} \cdot m$$

Denote  $q$  as the number of fine squares  $L$  in square  $K$ . Denote  $q_{\max}$  as the maximum number of fine squares  $L$  within one square  $K$ . By definition  $q_{\max}$  is 4 (4 fine squares  $L$  denoted as  $L_1, L_2, L_3, L_4$ ).

- If  $q = 4$  in square  $K$ , then the number of workshops to be visited in square  $K$  is the same as the number of workshops to be visited in squares  $L_1$  to  $L_q$

$$\frac{1}{n} \cdot M = \sum \left( \frac{1}{n} \cdot m_q \right)$$

- If  $q < 4$  in square  $K$ , then the number of workshops to be visited in cell  $L$  is:

$$\sum \left( \frac{1}{n} \cdot m_q \right)$$

and the number of workshops to be visited in the remaining part of cell K is:

$$\frac{1}{n} \cdot \left( M - \sum \left( \frac{1}{n} \cdot m_q \right) \right)$$

The sample of workshops to be visited was computed for each category (activity vs size) of units localised by the first extensive survey. When the calculation was leading to a fractioned number of units to be sampled, this number was rounded to the upper whole number. This ended in the fact that in each square, the actual proportion of sampling was  $1/n'$ , slightly different from the theoretical proportion of  $1/n$ :

$$\frac{1}{n'} \neq \frac{1}{n}$$

For the extrapolation of results from the sample to all Jepara, and for each category (activity vs size) of units, it is the actual proportion  $1/n'$  of the effectively sampled units vs the total number of units in each square K of the grid, which is computed, leading to extrapolated squares.

Denote C as one category of units (activity vs size), within the 18 categories which were found in the city.

Denote  $F_{CK}$  as a quantity measured through the sampling method for the category C, within a square K, according to the actual sampling rate of  $1/n'$ .

Denote  $E_{CK}$  as the quantity extrapolated from the quantity F for the category C, within a square K.

- $E_{CK}$  is:

$$E_{CK} = F_{CK} / \frac{1}{n'}$$

## ANNEXES

- Then the total extrapolated quantity  $E_c$  for Jepara (for the category C) is:

$$E_c = \sum F_{ck} / \frac{1}{n'}$$

- And for Jepara, the extrapolated total quantity for one activity (summing the units across different size categories) is:

$$E = \sum_C \sum_K F_{ck} / \frac{1}{n'}$$

(Dinas Perindustrian Kabupaten Jepara; Sandee dkk. 2002; Roda 2004b; Roda & Cadène 2005; Alexander & Alexander 2000; Nadvi dkk. 1998)  
(Schartzenberg 2004; Lazarovici 2004; Guizol dkk. 2005)